U.S. Robotics®

# COURIER™ HIGH SPEED MODEMS

— encompassing —

COURIER HST dual standard™

COURIER HST™

COURIER V.32™

# USER'S MANUAL

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## HOW TO USE THIS MANUAL

This manual provides operating instructions for the following three Courier high speed modems. These products have many valuable features in common, such as error control, dialing operations, and compatibility at 2400 bits per second (bps) and below. They differ only in their modulation options at rates above 2400 bps. As you use the manual, keep the following guidelines in mind for the modem you've purchased.

**Courier HST Dual Standard** — This modem is compatible with modems that use either USRobotics' HST modulation or CCITT V.32 modulation. You can set the modem to operate in either HST or V.32 mode, depending on what the remote modem requires. Follow the Quick Start directions in Chapter 3 or the more detailed instructions in Chapter 4.

**Courier HST** — This modem is the same as the Dual Standard modem, above, except that it does not operate in V.32 mode. However, the Courier HST is upgradeable to a Dual Standard with the addition of V.32 modulation at a later time. If you've purchased a Courier HST, disregard all instructions in this manual for V.32-mode operation. Keep the modem at its factory setting, B1, for HST mode.

**Courier V.32** — This modem is compatible with modems that adhere to CCITT recommendation V.32. If you've purchased a Courier V.32, disregard all instructions in this manual for HST-mode operation. Keep the modem at its factory setting, B0, for V.32 mode.

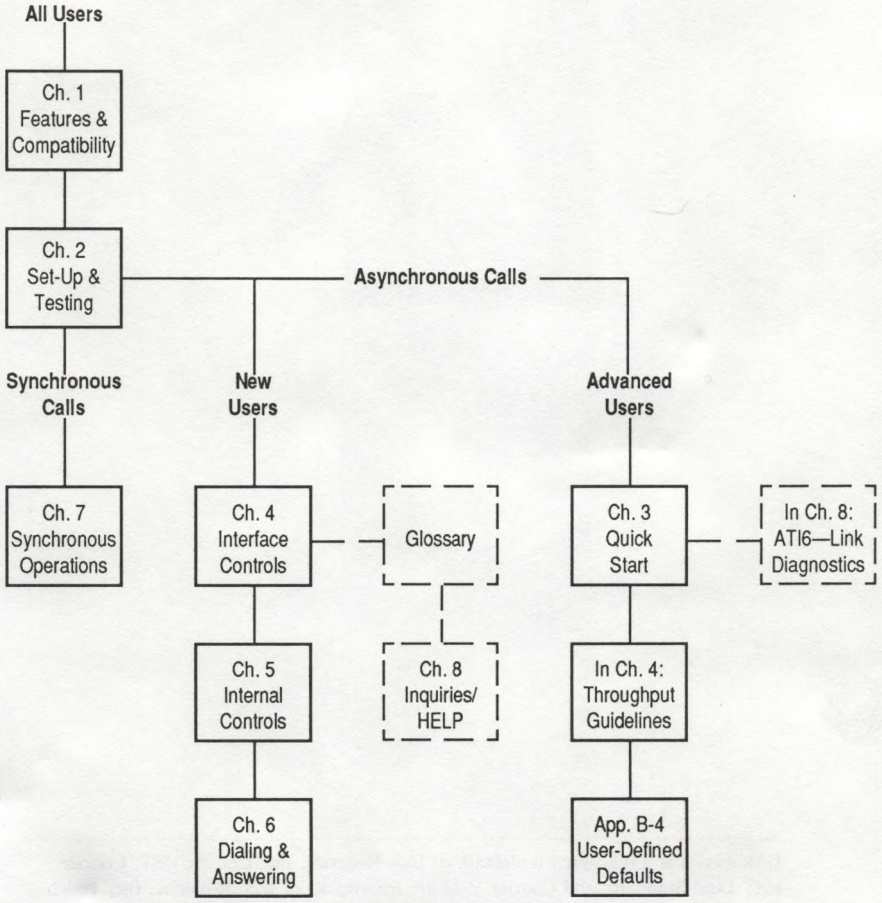
**Lower Speed Calls** — All three Courier modems connect automatically with remote modems operating at 2400/1200/300 bps, as long as the remote modems observe the standards listed under *Compatibility* in Chapter 1.

For easy tracking of information, we've supplied recommended paths through the manual. A diagram is on the next page.

## USER PATHS

The paths shown in the diagram below are suggestions only. They are designed for new and experienced users. Note that there is no separate path for HST-mode or V.32-mode operations.

Most users will be making asynchronous calls. Those making synchronous calls will find all essential information in Chapter 7, but may wish to review the more detailed operating instructions in other chapters.




Dashed lines indicate optional references. Additional points of reference:

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## LIMITED WARRANTY

U.S. Robotics, Inc., warrants to the original consumer or other end user purchaser that this product is free from defects in materials or workmanship for a period of two years from the date of purchase. During the warranty period, and upon proof of purchase, the product will be repaired or replaced (with the same or similar model) at our option, without charge for either parts or labor. This warranty shall not apply if the product is modified, tampered with, misused, or subjected to abnormal working conditions.

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REPAIR OR REPLACEMENT AS PROVIDED UNDER THIS WARRANTY IS THE EXCLUSIVE REMEDY OF THE PURCHASER. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE, AND U.S. ROBOTICS SHALL IN NO EVENT BE LIABLE TO PURCHASER FOR INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND OR CHARACTER.

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Some states do not allow the exclusion or limitation of incidental or consequential damages or allow limitations on how long an implied warranty lasts, so the above limitations or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

To obtain service under this warranty, contact the U.S. Robotics Technical Support Department at 800/982-5151 (in Illinois, 312/982-5151), or by mail at 8100 North McCormick Blvd., Skokie, Illinois, 60076. You will be given a Return Materials Authorization (RMA) number to help us keep track of your warranty request. Once you have received your RMA number, take or mail the product, postage prepaid, to U.S. Robotics at the above address. Include proof of the date of purchase. IMPORTANT: If you ship your unit, pack it securely, be sure your RMA number is visible on the outside of the package, and ship it charges prepaid and insured.

Should you encounter problems in operating this device, follow the instructions in Appendix D in Part II of this manual. The Appendix contains solutions to operating problems as well as procedures to follow if there is an apparent modem malfunction.

### FCC REGISTRATION

FCC68: CJE794-72748-MD-E
RINGER EQUIVALENCE: 0.4B
FCC15: CJE794-0093

### CONNECTING TO THE TELEPHONE COMPANY

It is not necessary to notify the telephone company before installing the modem. However, the telephone company may request the telephone number(s) to which the Courier is connected and the FCC information printed above.

If the telephone company has any questions or raises problems, ask them to call the Technical Support Department, USRobotics, Inc., 800/982-5151 (in Illinois, 312/982-5151).

If the modem is malfunctioning, it may affect the telephone lines. In this case, disconnect the modem until the source of the difficulty is traced. Do not use the modem on party or coin telephone lines.

## RADIO AND TELEVISION INTERFERENCE

This equipment generates and uses radio frequency energy and if not installed and used properly, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. Courier High Speed modems have been tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference in a residential installation.

However, there is no guarantee that interference will not occur in a particular installation. If this device does cause interference to radio or television reception, which you can determine by monitoring reception when the modem is on and off, try to correct the problem with one or more of the following measures.

Reorient the receiving antenna.
Relocate the computer with respect to the receiver.
Relocate the computer and/or the receiver so that they are on separate branch circuits.

If necessary, consult your dealer or an experienced radio/television technician for additional suggestions. You may find the following booklet, prepared by the Federal Communications Commission, helpful:

How to Identify and Resolve Radio-TV Interference Problems
Stock No. 004-000-0345-4
U.S. Government Printing Office
Washington, DC 20402

## FOR CANADIAN MODEM USERS

The Canadian Department of Communications (DOC) label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational, and safety requirements. The department does not guarantee the equipment will operate to a user's satisfaction.

Before installing this equipment, make sure you are permitted to connect it to the facilities of the local telecommunications company. You must also install the equipment using an acceptable method of connection. In some cases, you may also extend the company's inside wiring for single line individual service by means of a certified connector assembly (telephone extension cord). You should be aware, however, that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by a user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

For your own protection, make sure that the electrical ground connections of the power utility, telephone lines, and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

CAUTION: Do not attempt to make such connections yourself; contact the appropriate electric inspection authority or electrician.

Courier High Speed Modems Load Number: 41B

The Load Number (LN) assigned to each terminal device denotes the percentage of the total load to be connected to the telephone loop used by the device, without overloading. The termination on a loop may consist of any combination of devices, subject only to the requirement that the total of the Load Numbers of all the devices not exceed 100. An alphabetic suffix is also specified in the Load Number for the appropriate ringing type (A or B), if applicable. For example, LN = 41B designates a Load Number of 41 and a B-type ringer.

## INTRODUCTION

Your Courier modem represents powerful, advanced electronic design that offers exceptional reliability, compatibility and flexibility at rates ranging from 110 to 14,400 bits per second (bps).

### High Speed Modulation

The Courier line offers users two well-established methods of transferring data at high speed over the phone lines, USRobotics' High Speed Technology (HST) mode and CCITT V.32 mode.

**Courier HST Dual Standard and Courier HST Modems.** USRobotics' HST modulation allows calls at up to 14.4K bps, with optimal throughput of straight text files, under data compression, of around 25K bps. Data flows asymmetrically, at the high speed in one direction and at 450 bps in the other. The modems automatically allocate the high-speed channel to the modem with the most data to transmit. The efficiency of asymmetrical modulation derives from the fact that typical communications sessions involve brief messages typed at one end of the link and files sent from the other.

**Courier HST Dual Standard and Courier V.32 Modems.** V.32 modulation allows calls at up to 9600 bps, with optimal throughput of straight text files, under data compression, of around 16K bps. Data flows at 9600 bps in both directions at the same time.

### Asynchronous/ Synchronous Capability

Courier high speed modems operate synchronously as well as asynchronously. With a computer that has a synchronous interface adapter, you can call computers that use one of the standard synchronous protocols. See Chapter 7 for more information.

### Trellis Coded Modulation

At speeds above 2400 bps, in both asymmetrical and V.32 modes, Courier high speed modems use trellis coded modulation. This technique makes high speed data transmission less vulnerable to errors caused by the phone network. The modems can tolerate twice the amount of noise in the telephone channel than they could with conventional modulation (quadrature amplitude modulation, or QAM), so there are fewer error-control retransmissions. Trellis coded modulation is also less susceptible to impulse-type noise.

| | |
|---|---|
| Error Control | Error control is available in both HST and V.32 modes, at speeds of 1200 bps and above. With flow control, error detection, and retransmission of errored data blocks, you can be assured that your data is sent and received reliably. |
| Data Compression/ Throughput Gains | Courier high speed modems compress data to pack more information into each second of your calls. In addition, larger data blocks eliminate much of the added overhead (protocol information) associated with less powerful error-control protocols. |
| Rate Selection/ Flow Control | The Courier's transmit buffer allows you to set your computer-to-modem rate as high as 38.4K bits per second, for maximum performance. Flow control operations keep the buffer from overflowing and prevent data loss. |
| Shorter Response Time | High speed modems are generally most efficient for file transfers. You'll find that Courier high speed modems also offer faster response times during interactive sessions. |
| Programmable Nonvolatile Memory | You can tailor your own default settings and store them in nonvolatile random access memory (NRAM). Each time the computer is powered on, the Courier operates at the settings you've specified. |
| Link Rate Negotiation | Courier high speed modems automatically switch their link rates to match a lower rate of a remote modem, in both Originate and Answer modes. Or you can optionally set the modem to connect only at a specified rate. |
| Online Fallback/ Fall Forward | During high speed sessions, if severe line impairments threaten the integrity of data transfer, the modems fall back to the next lower speed. In HST mode at 14.4K bps, they fall back and retrain at 12K bps. If necessary, they fall back further, to 9600 and so on. In V.32 mode at 9600 bps, they fall back to 4800 bps. As line improvements occur, the modems automatically shift up to the next higher speed. |
| Link Diagnostics | After each call, you can display a Link Diagnostics screen containing information about the amount of data transferred, line operations, and the reason the call was disconnected. |
| Modem Diagnostics | The modem performs three loopback tests: analog, digital, and remote digital. See Appendix F for more information. |
| Inactivity Timer | You can set the modem to automatically hang up after a specified number of minutes if there is no activity on the phone line. |

**Call Duration Reporting**

The modem records the duration of your calls in hours, minutes, and seconds. This feature enables you to display and print an audit of your calling activities. You can optionally use the modem clock as a real-time clock.

**Call Progress Detection**

An optional set of result codes (screen messages) lets you know when a line is busy, a person rather than a modem has answered the phone, there is no dial tone, or the distant phone is ringing.

**Modem Settings Display**

On command, the modem displays its current settings, a handy way to check your transmission rate, S-registers and other operational controls. The modem also displays the settings in nonvolatile memory or its factory settings.

**HELP Screens**

The modem displays four screens that summarize the command sets, Dial command options, and S-register functions.

**Bottom Panel Reference**

Operational summaries and other information are printed on the bottom of the modem case. A Dual In-Line Package (DIP) switch guide makes it easy to tailor the switch settings to your requirements.

**Automated Redialing**

You can put the modem into Repeat Mode to automatically redial if a previous dial attempt fails to connect. This is especially useful in dialing services whose lines are often busy.

**Quote Mode**

Set the modem to Quote Mode if you want it to dial an alphabetic "number," such as 800-"DIAL USR" (USRobotics' Sales Department).

**Adaptive Dialing**

You can set the modem to first try Touch-Tone dialing. If tone dialing doesn't work on the line, the modem automatically switches to the slower type, pulse (rotary).

## COMPATIBILITY

Courier high speed modems maintain compatibility with a wide user base of installed 14.4K/9600/2400/1200/300 bps dial-up modems and existing software. Compatibility features include the following:

- Can be used with any computer or terminal that is compatible with the RS-232C standard interface.
- Can be used with any computer or terminal that uses ASCII, the standard character code supported by most equipment manufacturers.
- Connects with any asynchronous modem whose signal scheme is compatible with the following standards at the given data rate:

| Bits per Second | Standard |
|---|---|
| 300 | Bell 103 or CCITT V.21 |
| 1200 | Bell 212A or CCITT V.22 |
| 2400 | V.22*bis* |
| 9600 | USR-HST or CCITT V.32 |
| 14.4K | USR-HST |

- Connects with older systems whose equipment operates at rates varying between 110 and 300 bps.
- Connects in synchronous mode at standard rates with any system using a synchronous protocol compatible with your synchronous interface equipment.
- In HST mode, uses the HST error control protocol and MNP Service Level 5 (data compression) at 14.4K, 12K, 9600, 7200, and 4800 bps.
- In V.32 mode and at 2400 and 1200 bps, uses the MNP error control protocol, Service Levels 1–5.
- Is fully FCC-certified for the uses described in this manual.

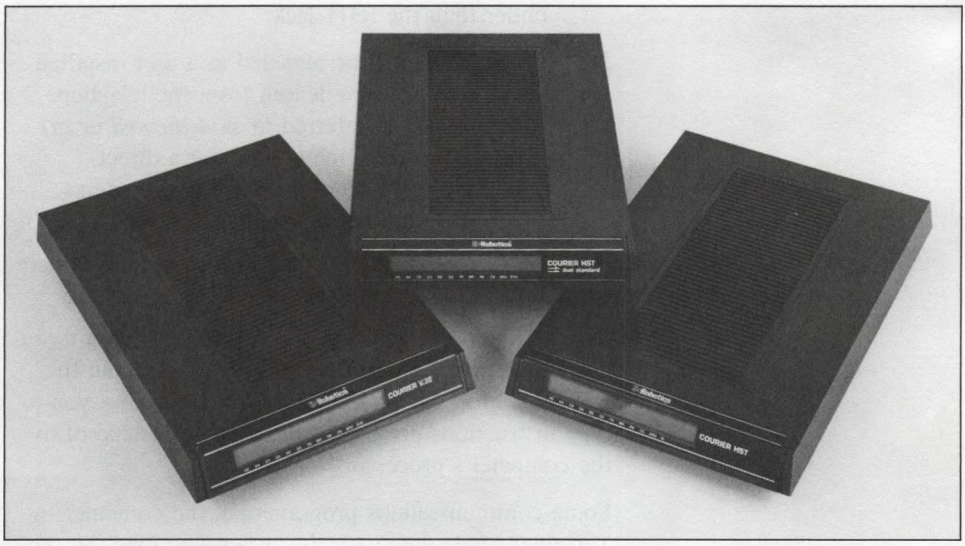



**Figure 2.1—Courier High Speed Modems**

## PACKAGE COMPONENTS

Your Courier modem package contains the following items in addition to this manual:

- The modem you purchased, the Courier HST Dual Standard, Courier HST or Courier V.32 modem
- An RJ11C phone cord
- A power adapter
- A Quick-Reference card, in the manual
- Your warranty card, to be filled out and returned to U.S. Robotics, Inc.

## OPERATIONAL REQUIREMENTS

The Courier modem has minimal operational requirements. Be sure to read the information in the front of this manual about radio and television interference and connecting to the phone company. In addition, you should be aware of the following:

- Follow the operating instruction in Appendix E-4 if the modem is to be used in either of the following types of installation.

1) The modem will be installed in a key system PBX in which RJ12 or RJ13 jacks are used rather than the RJ11 jack.

2) The modem will be attached to a user-installed phone line or a line leased from the telephone company. Often referred to as *dedicated* or *private*, this type of line is used for a direct, continuous connection between two modems. The connection is made without dialing.

- If the modem is installed in a Hewlett Packard system, be sure to follow the instructions in Appendix E-5.
- If you're working with a computer rather than a terminal, communications software is required to put the computer in *Terminal Mode*. This mode allows you to type instructions directly to the modem instead of to the computer's processor.

  Some communications programs put the computer in Terminal Mode automatically, when you load the program. Others require typing a function key, displaying a communications screen, or other operation. If necessary, refer to your communications software documentation for instructions.

### RS-232C Requirements

You'll need an RS-232C cable to connect the modem to your computer or terminal. Use a *shielded cable* to ensure minimal interference with radio and television reception.

The modem takes a DB-25P (25-pin plug, or male) connector, but computer equipment varies. Check the serial port at the rear of your machine, labeled MODEM, COMMUNICATIONS, EIA or with a phone symbol. (Don't use the port marked PRINTER or AUX.)

The port will be either a socket (female) or plug (male) that typically accommodates 25 or 9 pins. For example, the port on the IBM PC, XT and some compatibles requires a DB-25S (socket) connector, while the port on the IBM AT and some compatibles requires a DB-9S connector. Apple computers require a DB-25P, DB-9P or 8-pin round plug connector.

NOTE: Appendix B-1 defines the RS-232C pin assignments required to operate the modem. Be sure to check the appendix if you're not sure what type of cable you need, or if

you're building your own. If your machine has other than a 25- or 9-pin port, check your documentation to see what type of RS-232C connector is required.

*WARNING*

If you're using the fastest computer-to-modem rate of 38.4K bps, follow the instructions concerning the RS-232C cable at the end of Appendix B-1. The guidelines there will help you to avoid signal degradation at the 38.4K rate.

## ASSEMBLING THE MODEM

1. Turn off the computer or terminal and its peripheral devices.
2. Examine the label on the bottom of the modem. In addition to the summaries and other information, the label contains icons to aid in modem assembly. Check the interfaces at the back of the modem, shown in the following photograph.

**Figure 2.2—Interface End, Courier Modem**

3. Now review the attached interfaces in Figure 2.3.

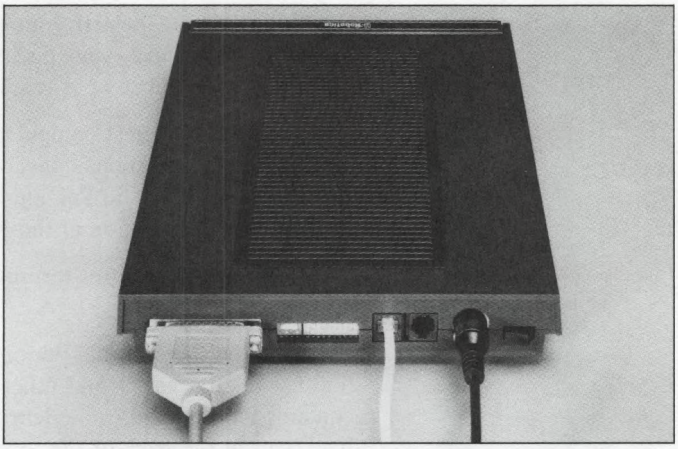


**Figure 2.3—Connected Courier Modem**

4. Check to make sure that the power switch is OFF; press it towards the zero in the 1/0 icon on the bottom label. Then plug the small end of the power supply cord into the power jack at the back of the modem, and plug the power adapter into a standard 115-volt AC wall socket.

   Disconnect your present phone cable from the wall jack. Plug one end of the phone cord that came with the modem into the modem's phone jack near the wall-jack icon; plug the other end into the wall jack.

   NOTE: Older telephone installations may not have the appropriate modular wall jack and plug. Adapters and RJ11C connectors are available from your telephone company or computer dealer.

   If you want to keep your telephone connected for conventional calls, plug its cord into the jack near the phone icon. You can also use both your telephone and modem in one call, although not at the same time. Appendix E-1, *Using Both Voice and Data Communications*, explains how to switch control of the phone line between the phone and the modem.

5. Next, check the positions of the bank of Dual In-Line Package (DIP) Switches located at the back of the modem. These switches are set at the factory to the positions most users require, as shown in Figure 2.4.

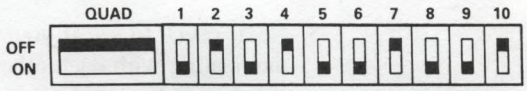



**Figure 2.4—DIP Switch Factory Settings**

Use the guide on the bottom of the modem or refer to the more detailed summary in Appendix B-3 to determine if your situation requires different settings. Also review your communications software requirements.

6. The final step is to connect the modem to the computer's or terminal's serial port with the RS-232C cable described earlier in this chapter. Attach the appropriate connectors to the modem and to the serial port.

NOTE: When you are using the modem, be sure not to cover the vents on the top of the case.

The modem is now ready to be tested and operated.

## TESTING

To verify that your modem is working properly, follow these steps:

1. Turn on your computer or terminal and clear the screen. Then turn the Courier's power switch ON. These front panel indicators will light up:

   CD Carrier Detect (if you haven't changed the factory setting of DIP switch 6)

   TR Data Terminal Ready (if you haven't changed the factory setting of DIP switch 1)

   MR Modem Ready/Power

   RS Request to Send, if your computer/terminal supports RTS on the RS-232C interface

   CS Clear to Send

2. If you're using a personal computer, load your telecommunications software. If your software requires, issue the command that lets you send commands to the modem, i.e., puts the computer in Terminal Mode. Some communications programs do this automatically upon loading. Others require displaying a communications or terminal screen, typing a Function key, or some other operation.

   If necessary, refer to your communications software documentation for instructions.

3. Next, check to see if your machine and modem are communicating with each other by typing the command to get the modem's *attention*.

   Type either upper or lower case letters, not a combination. Send every command to the modem by pressing the Enter (Carriage Return) key, shown in the example between angle brackets. Don't type the angle brackets.

   Type the following:

   AT <Enter>

   If everything is correct, the modem responds as follows:

   OK

   NOTE: The AT command is used alone to check the modem/terminal interface. AT is also the mandatory prefix for all other commands except A/ and A>, used to repeat execution of the command in the command buffer, and + + +, the escape code. These exceptions are explained in Chapter 6.

4. The modem is shipped with DIP switch 4 UP, causing the modem to display (echo) your keyboard commands. If your entered command is not displayed, your local echo is OFF. To turn the local echo ON, send the modem the following command.

   ATE1 <Enter>

   If double characters appear on the screen, both your modem and software are set to local echo ON. Either set your software to local echo OFF, or turn the modem's echo OFF with this command:

   ATE0 <Enter>

5. If no OK appears on your screen, check out the connections at the interface end of the modem. Then carefully review the previous instructions to see if you've missed something.

For information on other testing such as the Analog Loopback Self-Test, see Appendix F-2.

For synchronous operations, refer to Chapter 7. Unless you make synchronous calls, the modem will always operate in asynchronous mode.

## HIGH-SPEED MODULATION: HST/V.32

For connections above 2400 bps, select either HST or V.32 mode, as follows.

### *HST Mode (B1)*

Use this mode to connect at 14.4K or 9600 bps with USRobotics HST or HST-compatible modems. This mode is not valid for Courier V.32 modems.

Courier HST and HST Dual Standard modems are set at the factory to HST mode, B1. For calls at 2400 bps and lower, you'll find your connect time to be faster if you leave the modem set to B1.

### *V.32 Mode (B0)*

Use this mode to connect at 9600 bps with modems that follow CCITT Recommendation V.32. This mode is not valid for Courier HST modems except for international calls.

Courier V.32 modems are set at the factory to V.32 mode, B0. Courier HST Dual Standard modems must be reset from HST mode to V.32 mode, that is, from B1 to B0, to answer a V.32 call.

NOTE: Dual Standard modems connect with each other even if one is in HST mode and the other is in V.32 mode. Appendix E-3 describes the handshaking procedure.

## DATA FORMAT

The Courier and the remote modem must use the same ten-bit data format. The following table lists the allowable word lengths, parity and Stop bits. If a remote modem requires 2 Stop bits and the format totals 11 bits, the second Stop bit is not counted.

| Start Bits | Word Length | Parity (1 Bit) | Stop Bits |
|---|---|---|---|
| 1 | 7 | Even, Odd, Mark, Space | 1 |
| 1 | 7 | None, Even, Odd, Mark, Space | 2 |
| 1 | 8 | None | 1, 2 |

## DIALING

Use the following guidelines to call the specified type of modem at the indicated speeds. The guidelines assume you have not yet changed any of the factory settings.

### *HST-Compatible, 14.4K bps*

These instructions do not apply to the Courier V.32 modem.

Set your terminal/software to 38.4K or 19.2K bps. Type:

AT &B1 &H1 D *phone number* <Enter>

The command instructs the modem as follows:

| | |
|---|---|
| AT | Required AT prefix. |
| &B1 | Fixes the terminal/computer at the rate you have set. Required for the link rate to be 14.4K bps. |
| &H1 | Sets the modem for Clear to Send (hardware) flow control.* |
| D | Autodial the specified phone number. |
| <Enter> | Required Carriage Return (Enter key). |

* Clear to Send is supported by IBM PC, XT, AT and compatible computers as well as major communications software packages. Your software may require that you turn off XON/XOFF signaling (software flow control).

If you're not sure whether your computer or software supports Clear to Send signaling, substitute &H3.

### *HST-Compatible, 9600 bps*

These instructions do not apply to the Courier V.32 modem.

Set your terminal/software to 38.4K or 19.2K bps. You can also select 9600 bps, but you'll lose the advantage of better throughput at the higher speeds.

Follow the command instructions for a 14.4K call, above.

### *V.32-Compatible, 9600 bps*

These instructions apply to Courier V.32 and HST Dual Standard modems, but not to the Courier HST.

Set your terminal/software to 38.4K or 19.2K bps. You can also select 9600 bps, but you'll lose the advantage of better throughput at the higher speeds. Type:

AT B0 &H1 D *phone number* <Enter>

The command instructs the modem as follows:

| | |
|---|---|
| AT | Required AT prefix. |
| BØ | Sets the Dual Standard modem to V.32 mode; not required if the modem is already set to BØ.* |
| &H1 | Sets the modem for Clear to Send (hardware) flow control.** |
| D | Autodial the specified phone number. |
| <Enter> | Required Carriage Return (Enter key). |

* If you have trouble establishing the connection, you may need to increase or decrease the default value of S-Register 28. See S28 in Appendix B-5.

** Clear to Send is supported by IBM PC, XT, AT and compatible computers as well as major communications software packages. Your software may require that you turn off XON/XOFF signaling (software flow control).

If you're not sure whether your computer or software supports Clear to Send signaling, substitute &H3.

*MNP-Compatible, 2400 or 1200 bps*

The modem can be in either HST mode (B1) or V.32 mode (BØ). Set your terminal/software to 38.4K, 19.2K or 9600 bps. If you select 2400 bps, you'll lose the advantage of better throughput at the higher speeds. Type:

AT &H1 D *phone number* <Enter>

The command instructs the modem as follows:

| | |
|---|---|
| AT | Required AT prefix. |
| &H1 | Sets the modem for Clear to Send (hardware) flow control.* |
| D | Autodial the specified phone number. |
| <Enter> | Required Carriage Return (Enter key). |

* Clear to Send is supported by IBM PC, XT, AT and compatible computers as well as major communications software packages. Your software may require that you turn off XON/XOFF signaling (software flow control).

If you're not sure whether your computer or software supports Clear to Send signaling, substitute &H3.

*Non-MNP Compatible, 2400, 1200 or 300 bps*

The modem can be in either HST mode (B1) or V.32 mode (B0). Set your terminal/software to 2400 bps. Type:

AT &M0 D *phone number* <Enter>

NOTE: &M0 suppresses the MNP signals that may be misinterpreted by the remote system and prevent a successful connection. Also, see the flow control guidelines that follow. For calls at 110 bps, see the &B Command description in Chapter 4.

## FLOW CONTROL REQUIREMENTS

Flow control for Transmit and Received Data is disabled at the factory because of variations in computer and terminal equipment. However, Transmit Data flow control (&H1 or higher) is required in the following situations.

- You are using error control, with or without data compression, and the call is at 14.4K, 12K, 9600, 2400, or 1200 bps. Flow control prevents buffer overflow in the event that line disturbances cause frequent retransmissions.
- The rate at the local terminal interface is higher than the link rate, for example, your computer is sending at 19.2K bps and the modems connect at 9600 bps.
- The volume of data transfer is high.

Received Data flow control is optional. All flow control and rate settings are explained in Chapter 4.

## ERROR CONTROL

Error control is available in both HST and V.32 modes. We recommend that you *always enable error control for calls at 9600 bps and above.*

At its factory setting, &M4, the Courier includes an error control request when both modems establish the data link. If the remote modem fails to recognize the request, the Courier continues in non-error control mode.

In some installations, for example in networks, system software may perform the error control function. To avoid redundant error control, which may lessen throughput, you may want to disable error control. Set the modem to &M0 and to &N6 or &N8. Keep in mind, however, that an HST modem set to &M0 does not perform line reversals, that is, allocate the high-speed channel to the modem with the most data to transmit, and does not perform online fallback. See Appendix E-3 for more information.

### DATA COMPRESSION

The modem is set at the factory to negotiate for data compression (&K1). If the remote modem is not set for compression, the call proceeds without this operation.

Leave the modem set to its default *unless you are transferring files that are already compressed*, in which case you should disable data compression by setting the modem to &KØ. For more information, see the throughput guidelines at the beginning of Chapter 4 and the &K command description in that chapter.

### MAXIMUM THROUGHPUT

Use these settings for both HST modem models. The modem's factory settings for HST mode (B1) and data compression (&K1) are assumed.

| | |
|---|---|
| Terminal/software: | 38.4K bps |
| Modem: | Fixed terminal interface rate (&B1)<br>Variable link rate (&NØ)<br>Transmit Data flow control (&H1 preferred, &H2 or &H3) |

Use the same settings, or 19.2K bps, for V.32 mode, but be sure the modem is set to BØ.

### LINK RATE NEGOTIATION

During handshaking, the modems negotiate the highest possible rate, depending on each modem's capabilities. The Courier automatically switches rates to match the rate of the remote modem, within the following rate ranges. For more detailed information on handshaking, see Appendix E-3.

HST Mode: 14.4K/12K/9600/7200/4800/2400/1200 bps and, without error control, 300 bps

V.32 Mode: 9600/4800/2400/1200 bps and, without error control, 300 bps

### ONLINE FALLBACK

When online at high speeds, the modems monitor the condition of the phone line. If they sense disturbances that threaten data integrity, they fall back and retrain (resynchronize) at the next lower speed in their fallback range, as follows.

HST Mode: 14.4K/12K/9600/7200/4800 bps

V.32 Mode: 9600/4800 bps

If conditions remain poor, HST-mode modems continue to fall back to the next lower speed. As line improvements

occur, the modems fall forward to the next higher speed until they reach the rate they originally negotiated.

DATA RATE DEFAULTS

Terminal interface: &B0, detect rate from the AT command, then follow the connection rate.

Link interface: &N0, negotiate the highest possible rate with the remote modem.

The terminal interface and link rates may be set to fixed rates using &B1 or &N1–8, respectively. See Chapter 4.

Use the commands explained in this chapter to select modem settings at the terminal and link interfaces. These settings apply only to asynchronous operation. For synchronous calls, see Chapter 7.

## TERMINOLOGY

*ARQ* (automatic repeat request, i.e., retransmission) is the term used by USRobotics in error control commands and response codes.

The terminal or computer is referred to as the *DTE* (Data Terminal Equipment). The DTE rate is the rate at which your DTE and Courier modem communicate, e.g., 19.2K bps. The Courier modem is referred to as the *DCE* (Data Communications Equipment).

Figure 4.1 indicates which commands control modem operations at the DTE/DCE (computer-to-modem) and phone link (modem-to-modem) interfaces.

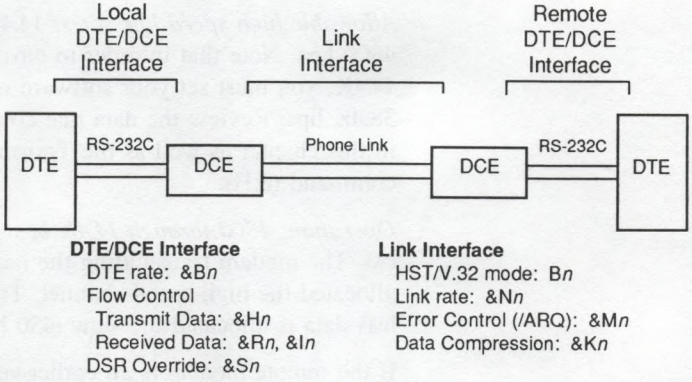



**Figure 4.1—Interface Control Commands**

## CHANGING SETTINGS

When you change a setting, the modem retains it until you do one of the following:

- Select a new setting.
- Issue the ATZ command to reset the modem to its software defaults. If DIP switch 10 is UP, the modem resets to the defaults stored in nonvolatile memory (NRAM). If DIP switch 10 is DOWN, the modem

resets to the factory settings stored in read-only memory (ROM).

Issuing the AT&F command also sets the modem to its factory settings.

- Turn the modem off, and power it on again. The modem then loads either the nonvolatile memory defaults (DIP switch 10 UP) or the factory settings (DIP switch 10 DOWN).

## HIGH SPEED MODULATION: HST/V.32

There are two popular methods of connecting at speeds above 2400 bps: USRobotics' High Speed Technology (HST) modulation and CCITT V.32 modulation. If you purchased a Courier HST Dual Standard, your modem connects with modems that use either modulation method. Courier HST modems connect with HST-compatible modems, and can be upgraded to include V.32 compatibility. Courier V.32 modems connect with V.32-compatible modems.

### HST Compatibility

The B1 setting enables HST mode. This is the factory setting for the Courier HST and the Courier HST Dual Standard.

*Allowable high speed link rates:* 14.4K, 12K, 9600, 7200, 4800 bps. Note that in order to have the modem connect at 14.4K, you must set your software or terminal to 19.2K or 38.4K bps. Review the data rate commands (&B and &N) in this chapter as well as the Transmit Data flow control command (&H).

*Operation, 4800 through 14.4K bps:* Data flow is asymmetrical. The modem transmitting the heaviest volume of data is allocated the high-speed channel. The modem transmitting less data is allocated the slow (450 bps) channel.

If the remote modem is an earlier-version HST with a 300-bps back channel, the Courier drops its back channel to 300 bps if error control is enabled (&M4 or &M5 setting). If error control is disabled (&MØ setting), you need to force the Courier's 300-bps back channel by turning on bit 2 of S-register 15. Type:

ATS15=4 <Enter>

Settings of BØ and S-register 28=Ø enable HST mode for calls originating overseas. See *International Calls*, at the end of Chapter 6.

### V.32 Compatibility

The BØ setting enables V.32 mode. This is the factory setting for the Courier V.32 modem, but must be user-selected to have the Courier HST Dual Standard answer V.32 calls.

*Allowable high speed link rates:* 9600 and 4800 bps. The Courier in V.32 mode does not establish connections with remote modems operating at any other rates above 2400 bps. Note that while throughput will be very good, it will not be as high as the throughput possible in HST mode, where the link rate can be 14.4K bps.

*Data Flow, 9600 and 4800 bps:* Data flow is symmetrical, that is, it flows in both directions at the same rate, 9600 or 4800 bps.

### Modulation at 2400 BPS and Below

At 2400 bps and below, all three Courier models use the same modulation techniques and are compatible with the wide user base of installed 2400, 1200 and 300 bps modems. Modulation at these speeds conforms with the following standards:

| BPS | Standard |
|---|---|
| 2400 | V.22*bis* |
| 1200 | Bell 212A (V.22 optional) |
| 300 | Bell 103 (V.21 optional) |

In addition, error control, DTE rates, flow control and other settings are unaffected by HST or V.32 operations.

## THROUGHPUT GUIDELINES

The following guidelines should help you to make the most of your modem's advanced performance features. In many instances, experimentation and experience will indicate what works best for your applications.

1. You will attain optimal throughput under the following conditions:

   - Your communications software allows fixing the DTE rate higher than the link rate, e.g., setting the terminal/software to 38.4K or 19.2K bps and setting the modem to &B1.

     If your software automatically switches bit rates to follow the connection (link) rate (9600, 2400, 1200, 300 or lower bps), you need to set the modem to &BØ for a variable DTE rate, and your throughput will be reduced.

- The call is under error control Service Levels 3 through 5, which includes data compression. See Appendix A for comparative throughput information on each successive level.
- Throughput is slightly higher for text files than for binary files such as .EXE or .COM files. For a comparative table, see Appendix A.

2. Compressing files that are already compressed, such as the .ARC files downloaded from many BBS's, degrades throughput. This is also true for random 8-bit binary files, which appear to the modem to be compressed. To avoid a decrease in throughput when transferring these and similar files, we recommend disabling data compression (&K0).

3. Many non-text files require a file transfer protocol, with varying throughput results. For example, certain public domain file transfer protocols have the following effects:

   Kermit — Throughput is severely reduced due to Kermit's short block lengths (under 128 bytes) and acknowledgment turn-around time.

   Xmodem — Throughput is severely reduced due to Xmodem's short block lengths (128 bytes) and overhead (error control protocol information).

   Ymodem — There is an improvement over Xmodem because of larger block lengths (1K bytes), but throughput is still reduced by the protocol's error control overhead.

   Ymodem-G and Zmodem are better choices, Ymodem-G being the most efficient. These protocols assume the modems are handling error control: overhead is minimal, with throughput almost equal to throughput with no file transfer protocol.

## ERROR CONTROL

Error control applies to both HST and V.32 modes. While error control is optional, *it should always be selected for sessions above 2400 bps.*

Under error control, the calling modem includes an error control request in its link negotiation signals. The answering modem may or may not recognize the request.

The error control protocol uses cyclic redundancy checking for error detection, and an automatic repeat request (ARQ) for retransmission of errored data blocks (or *frames*). See Appendix A for detailed information.

**Error Control Modes (&M*n*)**

NOTE: The &M*n* command is also used to set the Courier for synchronous operations. See Chapter 7 for information on operating the modem in synchronous mode.

**Warning**

Error control requires Transmit Data flow control, preferably the &H1 setting. The &H*n* command is described later in this chapter.

***&MØ***

Normal Courier mode, no error control. Use this setting if you're calling a non-MNP modem (2400/1200/300 bps), as the error control request may be misinterpreted by the remote system and prevent a connection.

NOTE: When Courier HST modems, or Courier HST Dual Standard modems in HST mode, are set to &MØ, there are limitations to operation above 2400 bps. See Appendix E-3.

***&M1***

Synchronous/smart mode. See Chapter 7.

***&M2***

Reserved.

***&M3***

Continuous synchronous mode. See Chapter 7.

***&M4***

Normal/ARQ mode. Default. If the remote modem does not recognize the Courier's error-control request, the Courier automatically operates in Normal mode (&MØ). Use this adaptive mode if error control isn't crucial for your call, and for flexibility in connecting with a variety of modems.

***&M5***

ARQ mode. If the remote modem does not recognize the error-control request, the Courier hangs up. Use this setting if error control is an absolute requirement.

***With Auto Answer***

To use error control for incoming calls, set the modem to Auto Answer and to either &M4 or &M5. When calls come in, the Courier goes off hook and responds to an error-control request if one is sent. If the Courier does not receive a request and is set to Normal/ARQ mode (&M4), it answers the call in Normal mode. If it does not receive a request and is set to ARQ mode (&M5), it hangs up.

### Data Compression (&K*n*)

Data compression is implemented through Level 5 of the MNP error control protocol, and only occurs if the modems can establish an ARQ connection. In addition to the obvious benefits to file transfer, compression speeds up interactive applications by filling the screen more quickly.

Appendix A describes the ARQ-connection sequence at all five protocol levels and includes a comparative table for different types of compressed files.

*&KØ* Data compression disabled. Some files should not be compressed and require this setting. See the throughput guidelines at the beginning of this chapter.

*&K1* Auto enable/disable. Default. The modem enables compression if the DTE rate is fixed, &B1. The modem disables compression if the DTE rate switches to match the connection rate, &BØ. (When the DTE and link rates are equal, there is no throughput advantage from data compression.) See the &B command later in this chapter.

If the remote modem doesn't recognize the request for compression, the ARQ connection proceeds at the last negotiated protocol level.

*&K2* Data compression enabled. Use this setting if you do not want the modem to automatically disable compression. If the remote modem does not recognize the request for compression, the ARQ connection proceeds at the last negotiated protocol level.

### FLOW CONTROL

This feature controls the flow of data into and out of the modem's Transmit and Receive data buffers, and is used for both error controlled and normal connections. Due to differing user equipment requirements, however, the Courier is shipped with all flow control options disabled.

Users at Hewlett Packard installations using the ENQ/ACK protocol should note the HP settings, &I3 and &I4, described under *Received Data Software Control (&In)*.

NOTE: Flow control of data from the DTE to the modem *is required* under the circumstances described under *Transmit Data Flow Control (&Hn)*. Received Data flow control is not as critical unless, for example, you are writing incoming files to disk on a slow computer. For information on flow control concepts, refer to Appendix A.

*Transmit Data Buffer Sizes*

The size of the Transmit data buffer depends on whether the connection is under error control or not, as follows.

- ARQ connections: 3.25K bytes.
- Non-ARQ connections: 1.5K bytes, allowing use of error control file transfer protocols such as Xmodem and Ymodem without flow control.

  If bit 3 of S-register 15 is turned on, the non-ARQ buffer size is reduced to 128 bytes, for the convenience of some remote users of slower modems. See S-register 15 in Appendix B-5.

*Received Data Buffer Size*

The size of this buffer remains constant at 2K bytes.

Transmit Data Flow Control (&H*n*)

This type of flow control is for data transmitted by your computer or terminal (DTE) to the modem. The modem monitors its buffer as data comes from the DTE. If the buffer approaches 90% capacity, the modem signals the DTE to stop transmitting. When the modem has sent enough data over the link to half empty the buffer, it signals the DTE to resume transmitting.

*When it is Required*

Transmit Data flow control should be enabled in the following situations:

- You're using error control (any allowable speed above 300 bps), with or without data compression.
- The DTE rate is higher than the link rate, e.g., the DTE is sending data to the modem at 38.4K or 19.2K bps and the link rate is 14.4K bps.
- The volume of data transfer is high.

*Hardware Control*

The modem lowers the Clear to Send (CTS) signal on the RS-232C interface when its buffer nears 90% capacity. The modem raises CTS when the buffer is about half full.

NOTE: If your terminal or communications software supports CTS, use hardware control as it is more efficient and does not affect the data stream.

Warning

If you are using an Xmodem-type protocol to transfer binary files, always use hardware flow control. If your system does not support CTS, *disable flow control*, and be sure the terminal and link rates are equal by setting the modem to &BØ and &NØ.

*Software Control*

The modem sends the conventional ASCII Transmit on/off (XON/XOFF) characters, depending on how full the buffer is, as follows:

| | | |
|---|---|---|
| XON | <Ctrl>-Q | (ASCII 17 Decimal, 11 Hex) |
| XOFF | <Ctrl>-S | (ASCII 19 Decimal, 13 Hex) |

The ASCII characters may be user-defined; see S-registers S22 and S23 in Appendix B-5 and the ASCII chart in Appendix B-6.

*&H0* Transmit Data flow control disabled. Default.

*&H1* Hardware flow control. Recommended setting. Requires that your terminal or software supports CTS.

If your software requires you to select either CTS (hardware) or XON/XOFF (software) control, turn off XON/XOFF signaling.

*&H2* Software flow control. Requires that your software support XON/XOFF signaling.

*&H3* Use both hardware and software flow control. If you are unsure about what your equipment supports, select this option.

Received Data Flow Control

Separate commands, &R*n* (hardware) and &I*n* (software), control the flow of Received Data passed by the Courier to your DTE. If the DTE rate is 9600 bps or above, there may be a need at times to signal the modem to temporarily stop passing data, for example, to read what's on the screen.

*Hardware Control (&Rn)*

If your terminal or software supports Request to Send (RTS) on the RS-232C interface and RTS is not always high, the DTE lowers RTS to signal the modem to stop passing it received data, and raises RTS when it is ready to receive.

*&R0* Enables a delay before the modem sends a CTS signal in response to RTS from the DTE. The delay is required by some synchronous mainframes and does not apply to asynchronous calls. The duration of the delay is set using S-register 26. See Chapter 7 for synchronous operations and S26 in Appendix B-5.

*&R1* The modem ignores RTS. Default. This setting is required if your DTE does not support RTS.

*&R2* Hardware flow control of received data enabled. The modem only sends data to the DTE when RTS is high.

*Software Control (&In)* Use of this feature requires that your software support XON/XOFF signaling. When you type <Ctrl>-S (the XOFF signal), the modem stops passing received data to the DTE. When you type <Ctrl>-Q (the XON signal), the modem resumes.

Warning When software flow control is enabled, the modem looks for <Ctrl>-S or <Ctrl>-Q characters. If these characters occur in a file, they will be misinterpreted as flow control characters and may be dropped from the data stream.

This is particularly important if you are using an Xmodem-type protocol and/or transferring binary files. We recommend that, if possible, you *select hardware flow control instead*. If that is not possible, disable flow control entirely (&H0, &R1, &I0), and keep the DTE and link rates equal by setting the modem to &B0 and &N0.

*&I0* Disables XON/XOFF flow control of received data. Default. Recommended for non-ARQ (Normal mode) calls, but see &I5. This option makes all characters except the escape code sequence (+ + +) transparent to the modem, because the modem does not look for control characters.

NOTE: Because of the risk just described, the settings that follow are only recommended for users who cannot use hardware flow control.

*&I1* The Courier acts on your typed XON/XOFF signals, and passes them to the remote computer. Use in ARQ mode only, but keep in mind that the XON/XOFF signals sent to the remote computer may interfere with XON/XOFF signaling occurring at the remote computer/modem interface. See &I2.

*&I2* The Courier acts on your XON/XOFF signals, but removes them from the data stream instead of passing them to the remote computer. This ensures that the remote computer does not confuse your XON/XOFF signals with those from its attached modem. This is the recommended setting for ARQ mode.

However, if the call is not in ARQ mode, there is no flow control on the phone link. If you send an XOFF to your modem and it stops passing on data, there is no way to tell the remote computer and modem to stop sending, and your modem's buffer may overflow. For more reliable control in non-ARQ mode, see &I5.

*&I3* Hewlett Packard protocol—Host Mode. Applies only to modems attached to an HP mainframe. See Appendix E-5 for further instructions.

*&I4* Hewlett Packard protocol—Terminal Mode. Applies only to modems attached to terminals in an HP system. See Appendix E-5 for further instructions.

*&I5* This setting is particularly designed to enable flow control on the phone link when the connection is not under error control.

At &I5, a Courier in ARQ mode operates the same as it does when set to &I2. It acts on your XON/XOFF signals but does not pass them to the remote system. The error control protocol enables the modems to control the flow of data on the phone link.

In non-ARQ mode, a Courier set to &I5 operates as though flow control were disabled (&I0) in respect to the local DTE interface. However, it looks to the phone line for *incoming* XON/XOFF signals. When the *remote* operator sends XON/XOFF signals, the Courier either resumes or stops transmitting data over the link and drops the signals from the data stream.

If both modems are set to &I5, operators at each end can signal the remote modem to stop sending, thereby controlling the data flow on the phone link and preventing their own modem's buffer from overflowing. At the DTE/DCE interfaces, the modems independently control the flow of data through their Transmit Data (&H) settings.

## DATA RATE COMMANDS

These commands allow you to select *variable* or *fixed* data rates at the DTE and link (modem-to-modem) interfaces. The highest possible rate at the DTE interface is 38.4K bps. The highest possible rate at the link interface is 14.4K bps if your Courier has HST-mode capability, 9600 bps if your Courier has only V.32 capability.

### Variable Rates

At the modem's default settings (&BØ, &NØ), the modem initially detects its rate from the rate of the AT command sent from the DTE. That rate is determined by the terminal or software setting.

When originating or answering a call, the Courier and the remote modem negotiate the highest possible link rate. For example, if the DTE sends the AT command at 19.2K bps and the Courier calls a modem operating at 1200 bps, the Courier automatically falls back to 1200 bps. The Courier notifies the DTE of the rate switch by sending the result code CONNECT 1200.

The Courier readjusts to the rate of the next AT command or, if auto answering a call, again switches to the rate of the remote modem. See Appendix E-2 for more details.

NOTE: If your software switches its rate to match the connection rate, reset the software for a higher speed call before dialing again. For example, if your modem and software dropped back to a lower rate for the last call and you want to make a high-speed call, first reset the software. Otherwise your Dial command is sent at the previous, lower rate. This causes the remote modem to drop back to match your lower rate.

### Fixed Rates

If your software supports fixed rates, you can fix the rate at either the terminal or link interface, or both. These settings apply to both normal and error-control operations, but *be sure to enable Transmit Data (&H) flow control.*

### Maximum Throughput Settings

For the greatest throughput, recommended settings (assuming software allows fixing the DTE rate) are as follows. The link rate is left variable so that the Courier will connect with modems operating at a variety of link rates, yet maintain the high DTE rate for greater throughput. Data compression is enabled as well. Transmit Data flow control is required. The modem may be in HST mode (B1) or V.32 mode (BØ).

| | |
|---|---|
| Terminal/software: | 38.4K bps |
| Modem: | Fixed DTE rate (&B1) |
| | Variable link rate (&NØ) |
| | Data compression (&K1) |
| | Transmit Data flow control (&H1, 2 or 3) |

**DTE Rate Select (&B*n*)**

Use this command to select variable or fixed rates at the DTE interface.

*&BØ* Variable rates. Default. The DTE rate switches with the connection (link) rate. Requires &NØ for the link rate: the modem & the DTE automatically switch to the link rate of the remote modem.

*&B1* Fixed rate: requires software support of this feature. Allowable terminal/software settings are 38.4K, 19.2K, 9600, 4800, 2400, 1200, 300 bps. We recommend setting the terminal to 38.4K or 19.2K bps to enable the greatest throughput.

*&B2* The modem observes the &B1 setting (fixed DTE rate) for calls over 2400 bps, but acts as if it were set to &BØ if the remote modem operates at 2400 bps or below.

This option allows greater flexibility for operators who receive calls from a wide variety of modems, particularly slower non-MNP modems. The Courier should also be set to X1 or higher, for rate-specific Connect messages, and to QØ or DIP switch 3 DOWN, to enable result codes. This allows you to reset your software when the modem sends the low-speed result codes.

***Guidelines for Low-Speed Calls***

*Calls at 300 bps:* Set the modem to &B1 or &B2 and, if your teminal or software rate is higher than 300 bps, to &H1 or higher. See the &N command that follows before deciding on how to set the link rate.

NOTE: Use the &BØ setting at 300 bps only if the remote modem is operating at 300 bps and the system it is attached to (usually older equipment) operates at 110–300 bps. In addition, you must first drop your DTE rate to 300 bps if you want to send the modem the escape code sequence of + + + to bring the modem back to Command mode. The modem ignores the &H setting.

*Calls at 110 bps:* Set the modem to &BØ and &NØ, and your terminal or software to 110 bps. The modem then will only communicate with a modem that is operating at 110 bps. The Courier ignores its &H setting.

If the Courier is set to &B1 or &B2 and you set your DTE to send at 110 bps, the DTE transmits to the modem at 110 bps. However, the modem sends your data over the phone link at 300 bps using Bell 103 modulation. If the remote modem is operating at 110 bps, the call will be unsuccessful.

### Link Rate Select (&N*n*)

Use this command to select variable or fixed rates at the link interface. Variable rates allow the modem to connect with a variety of remote modems.

*&NØ* Variable operations. Default. Recommended setting. The link rate varies according to the modems' connection sequence.

*&N1–8* Fixed link rate: the modem only connects if the remote modem is also operating at the same rate. The setting may be lower than or equal to the DTE rate, never higher. If lower than the DTE rate, enable Transmit Data (&H) flow control to prevent the possibility of data loss.

If you wish, you can filter out calls at other than a specific speed, for security or other reasons, by fixing the link rate. Allowable link rates are as follows. Rates above 9600 bps are not valid for V.32 operation.

| | | | |
|---|---|---|---|
| &N1 | 300 bps | &N2 | 1200 bps |
| &N3 | 2400 bps | &N4 | 4800 bps |
| &N5 | 7200 bps | &N6 | 9600 bps |
| &N7 | 12.K bps | &N8 | 14.4K bps |

### DSR OVERRIDE (&S*n*)

The Data Set Ready (DSR) function at the RS-232C interface is required on some systems to enable the modem to signal the terminal when the modem is ready to answer a call. Typically, DSR signaling is overridden.

*&SØ* DSR is always ON (override). Default.

*&S1* The modem controls DSR.

The commands explained in this chapter are of two types. The first group concerns default configurations, for example, writing your own power-on defaults to nonvolatile random access memory (NRAM). The remaining commands are used to select the modem's local operating characteristics, for a current session or to include in your default configuration. They include result code, echoing, and other options.

NOTE: When you change a default setting during a session, the modem retains that setting until you do one of the following:

- Select a new setting.
- Issue the ATZ command to reset the modem to its software defaults. If DIP switch 10 is UP, the modem resets to the defaults stored in nonvolatile memory (NRAM). If DIP switch 10 is DOWN, the modem resets to the factory settings stored in read only memory (ROM).
- Issuing the AT&F command resets the modem to its factory settings.
- Turn the modem off, and power it on again. The modem then loads either the nonvolatile memory defaults (DIP switch 10 UP) or the factory settings (DIP switch 10 DOWN).

## SETTING/USING DEFAULTS

The Courier is shipped from the factory with its software defaults stored in read only memory (ROM) and also in programmable nonvolatile random access memory (NRAM). The inclusion of NRAM allows you to program your own configuration and save the settings as your power-on defaults.

### Writing Defaults to NRAM (&W)

If you store your own default software settings in NRAM, the Courier loads those settings when it is powered on if DIP switch 10 is UP (factory setting).

A list of the settings stored in NRAM is in Appendix B-4. You can also display the settings by selecting option 5 of the I (inquiry) command:

ATI5 <Enter>

If you've sent the modem commands to change settings throughout your session and want to save your current configuration, send just the &W command:

AT&W <Enter>

You may also specify the entire configuration in a single command string that ends with the &W command. The following example sets the modem for the current session and stores the configuration in NRAM.

AT X4 &B1 &M5 &H1 M3 &W <Enter>

After sending a configuration to NRAM, you can change any current setting, for example change X4 to X7, and the NRAM configuration remains intact. To modify an NRAM setting, however, write it to NRAM, for example:

AT X7 &W <Enter>

### Loading the Factory Defaults (&F)

Factory defaults are permanently stored in the modem's ROM. They are listed in the table of NRAM settings in Appendix B-4. If DIP switch 10 is DOWN, the factory settings are loaded at power on instead of the NRAM defaults.

If the NRAM defaults are loaded at power on (DIP switch 10 UP) and you want to load the factory defaults instead, use the following command:

AT&F <Enter>

To just view a list of factory defaults, first load them and then use the I4 inquiry option:

AT&F I4 <Enter>

The modem displays a list of the factory defaults.

### Software Reset (Z)

If you've changed several current settings and want to reset to your power-on defaults, type the following command:

ATZ <Enter>

The modem resets either to its NRAM defaults (DIP switch 10 UP) or factory settings (DIP switch 10 DOWN).

NOTE: Use the ATZ command also to initiate a new setting for DIP switches 2–5 and 9. The only other way to initiate a new setting for any of those DIP switches is to turn the modem off and on again.

### Storing Telephone Numbers (&Z*n*=*s*)

The modem stores up to four frequently dialed phone numbers. Write the numbers to NRAM with the &Z*n*=*s* command, where *n* is position Ø through 3, and *s* is the phone-number string.

The number-string may be up to 36 characters long, including any Dial command options. The following example includes the tone-dial (T) and wait for a second dial tone (W) options of the Dial command. The number is stored at position Ø, assumed because there is no *n* parameter.

```
AT&Z=T9W5551234 <Enter>
```

The DS*n* command is used to dial a stored number, as in this example to dial the number stored at position 2:

```
ATDS2 <Enter>
```

NOTE: Do not include modem settings in the &Z string. If the call requires a special setting, insert it in the command string before the DS*n* command. In the following example, &MØ (no error control) is substituted for the user's error control default setting:

```
AT&MØ DS2 <Enter>
```

After the call, you may want to return to the default error control mode, for example:

```
AT&M4 <Enter>
```

## RESULT CODES

Four commands control the result codes that the modem returns to the screen:

| | |
|---|---|
| V*n* | Numeric/verbal response mode |
| Q*n* | Display/suppress all result codes |
| &A*n* | Display/suppress /ARQ result codes |
| X*n* | Result code subset |

### Response Modes (V*n*)

Result codes are sent to the screen in either words (Verbal Mode) or numbers (Numeric Mode). The Courier is factory set to Verbal mode when it is powered on (DIP switch 2 is UP). Use the V command to select verbal/numeric result codes independently of the DIP switch setting.

*V0* Numeric Mode. Numeric result codes are followed by a Carriage Return but no Line Feed, as in the following example, where a 3 is returned (for NO CARRIER).

ATD1234567 <Enter>

becomes

3TD1234567 <Enter>

*V1* Verbal Mode. Verbal responses are preceded and followed by a Carriage Return and a Line Feed, as in the following example:

ATD1234567 <Enter>
NO CARRIER

Quiet Mode (Q*n*) Enable/suppress the display of result codes. The Courier is shipped with DIP switch 3 DOWN, to display result codes. The command options control the display independently of the switch setting.

*Q0* Result codes are displayed.

*Q1* Result codes are suppressed (made *quiet*). This is useful when the messages might interfere with the data stream.

/ARQ Result Codes (&A*n*) If these codes are enabled, one of the following results is sent to the screen when a successful error control connection is established. Message 14 is displayed if the modem is set to X0 and the connection is at any rate from 1200 to 14.4K bps. Messages 15 to 17 and 19 indicate the connection rate and require a setting of X1 or higher.

(14) CONNECT /ARQ
(15) CONNECT 1200/ARQ
(16) CONNECT 2400/ARQ
(17) CONNECT 9600/ARQ
(19) CONNECT 4800/ARQ

*&A0* /ARQ codes are disabled. If your software does not allow the /ARQ result codes, use this setting. Suppression of the /ARQ codes doesn't affect the error control protocol; the modem returns the standard CONNECT messages.

*&A1* /ARQ codes are displayed. Default.

Result Code Sets (X*n*) You have eight options, 0 through 7, for selecting the result code subset best suited to your applications.

*X0* Basic subset, returns the first five codes (0–4) in the following table.

*X1* Extended subset, codes 0–5, 10, 13 and 18. Default. This set adds rate-specific CONNECT messages to the Basic set.

*X2–7* These options offer advanced call-progress codes and functions.

**RESULT CODES OPTIONS TABLE**

| | Setting | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Result Codes | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X7 |
| 0/OK | ● | ● | ● | ● | ● | ● | ● | ● |
| 1/CONNECT | ● | ● | ● | ● | ● | ● | ● | ● |
| 2/RING | ● | ● | ● | ● | ● | ● | ● | ● |
| 3/NO CARRIER | ● | ● | ● | ● | ● | ● | ● | ● |
| 4/ERROR | ● | ● | ● | ● | ● | ● | ● | ● |
| 5/CONNECT 1200 | | ● | ● | ● | ● | ● | ● | ● |
| 6/NO DIAL TONE | | | ● | | ● | | ● | ● |
| 7/BUSY | | | | ● | ● | ● | ● | ● |
| 8/NO ANSWER | | | | ● | ● | ● | ● | ● |
| 9/RESERVED | | | | | | | | |
| 10/CONNECT 2400 | | ● | ● | ● | ● | ● | ● | ● |
| 11/RINGING | | | | | | ● | ● | ● |
| 12/VOICE | | | | | | ● | ● | |
| 13/CONNECT 9600 | | ● | ● | ● | ● | ● | ● | ● |
| 18/CONNECT 4800 | | ● | ● | ● | ● | ● | ● | ● |
| Functions | | | | | | | | |
| Adaptive Dialing | | | ● | ● | ● | ● | ● | ● |
| Wait for 2nd Dial Tone (W) | | | | ● | ● | ● | ● | ● |
| Wait for Answer (@) | | | | ● | ● | ● | ● | ● |
| Fast Dial | | | ● | | ● | | ● | ● |

NOTE: CONNECT/ARQ messages (14–17, 19) indicate an error-control connection. See */ARQ Result Codes (&An)* earlier in this section.

Result Code Definitions

| | |
|---|---|
| 0/OK | Command has been executed |
| 1/CONNECT | Connection successful; if X1 or higher is set, connection is at 300 bps |
| 2/RING | Incoming call is ringing on phone line |
| 3/NO CARRIER | Hung up because attempt to connect failed or call was disconnected |
| 4/ERROR | Invalid command |
| 5/CONNECT 1200 | Connection at 1200 bps |
| 6/NO DIAL TONE | Hanging up; no dial tone |
| 7/BUSY | Hanging up; busy signal |
| 8/NO ANSWER | Hanging up; wait for answer (@ dial option) unsuccessful |
| 9/Reserved | |
| 10/CONNECT 2400 | Connection at 2400 bps |

| | |
|---|---|
| 11/RINGING | Dialed and remote phone is ringing |
| 12/VOICE | Hanging up; voice answered |
| 13/CONNECT 9600 | Connection at 9600 or 14.4K bps |
| 18/CONNECT 4800 | Connection at 4800 bps |

**Functions**

Adaptive Dialing: When set to X2 or higher, the modem dials using touch-tones, which is faster than pulse (rotary) dialing. If touch-tones don't work on the line, the modem reverts to pulse dialing.

W and @: These are Dial command options described in Chapter 6.

Fast Dial: When set to X2, X4, X6 or X7 the modem immediately dials when it detects a dial tone. At other X settings, the modem follows the S-register 6 setting, whose default wait time is 2 seconds.

## LOCAL ECHO

Two commands control what the modem displays on the screen. The E*n* command applies to when the modem is in Command Mode. The F*n* command applies to when the modem is online to another system.

**Command Mode Local Echo (E*n*)**

The E*n* command enables/disables the display of your typed commands. If double characters appear on the screen, both the modem's local echo and the software's local echo are on. The Courier is shipped with DIP switch 4 UP, enabling local echo. The commands here control the local echo independently of the switch setting.

*E0* Command Mode echo OFF. The modem does not display keyboard commands.

*E1* Command Mode echo ON.

### Online Local Echo (F*n*)

This command causes the modem to display a copy of the data it is transmitting to another system. Many systems, however, return a copy of received data, which is called a remote echo. If the modem's online echo is ON and there is also remote echoing, double characters appear on the screen.

In some microcomputer documentation the online echo setting is called the "Duplex" setting, although the term is not technically accurate.

*F0* Online echo ON. Sometimes called Half Duplex. As the modem transmits data to a remote system, it also sends a copy of the data to the screen.

*F1* Online echo OFF. Sometimes called Full Duplex. Default.

### THE AUDIO MONITOR

The modem's speaker enables you to monitor the dial connect process. There are several ways to make use of this feature. After the Courier dials a number, it waits 60 seconds for a high-pitched answer tone from the other modem, immediately followed by data signals, called a *carrier.* These signals must occur before a data link is established.

If someone answers the phone, or if the line is busy, the modem sends the message NO CARRIER to your screen after 60 seconds. If you listen to the speaker, you can respond immediately instead of waiting for the modem to time out.

For example, if you hear someone answering the call, you might pick up the phone and talk to the person or cancel the call by pressing any key on the keyboard. In the same way, you can cancel a call when you hear a busy signal.

You can also hear if dialing is proceeding too fast for the system. Terminate the call (press any key) and retype the Dial command with a comma or two to allow for more time. This applies to accessing an outside line (dialing 9, for example) as well as to check whether a public service has enough time to respond to your account number or other code.

**Speaker Control (M*n*)**

This command disables the speaker entirely or sets the speaker to monitor different segments of the dial-connect sequence.

*MØ* This setting disables the speaker entirely so that you don't hear the modem go off hook, dial, etc.

*M1* The speaker is ON until Carrier Detect. Default. You can monitor call progress until the Courier detects the remote modem's carrier signals, or until the 60-second timeout and result code display. At Carrier Detect, the modem disconnects the speaker and data transmission sounds are suppressed.

*M2* The speaker is ON continuously, including during data transmission.

*M3* The speaker doesn't go ON until after the last digit is dialed, then goes OFF at Carrier Detect.

**MODEM CLOCK USAGE (K*n*)**

The modem clock is used as a call-duration timer or as a real-time clock. Used in conjunction with the I*n* (Inquiry) command, the modem returns the duration of the last call in hours, minutes, and seconds or the actual time.

*KØ* Call-Duration Mode. Default. The modem times each call from CONNECT to NO CARRIER, and stores the information until the next connection or when the modem is reset. At ATI3 <Enter>, the modem displays the call's duration. If you wish, you can maintain a call log by printing this information after each call.

*K1* Real-Time Mode, The clock operates as a real-time clock regardless of the presence of a carrier. Set the clock (in military time) by specifying the hour, minutes, and seconds as in the following example, which sets the clock at the real time of 1:30 p.m.

```
ATI3=13:30:00 K1 <Enter>
```

At ATI3, the modem displays the real time. You'll need to set the clock each time you power on the modem, but the clock is not affected by the reset command, ATZ.

### TRANSMITTER ENABLE/DISABLE (C*n*)

If an additional terminal and modem share the phone line for monitoring purposes, the second modem is placed in Receive Only state by disabling its transmitter. *Use this feature only at 1200 or 300 bps.*

*C0* Transmitter disabled. Modem is set to Receive Only.

*C1* Transmitter enabled. Default.

### BREAK HANDLING (&Y*n*)

This command allows you to send a break to abort data transfer without disconnecting from the phone link. The following options are available.

NOTE: A destructive Break to the modem resets its data compression tables. The remote modem also resets its data compression tables.

*&Y0* Destructive, no Break transmitted: the modem clears the data from its transmit buffer (all data is lost) but does not pass on the Break to the remote modem.

*&Y1* Destructive, expedited: the modem clears the buffer and immediately sends a Break to the remote modem. Default.

*&Y2* Nondestructive, expedited: the modem retains data in the transmit buffer, but immediately sends a Break to the remote modem.

*&Y3* Nondestructive, unexpedited (send Break in sequence): the modem transmits any buffer data received before the Break, sends the Break, and then sends any subsequent input from the computer or terminal.

### THE S-REGISTERS

The S-Registers are used to set various timing parameters and other operations, including redefinition of selected ASCII characters. The defaults reflect typical requirements of most users.

A detailed summary of the S-register functions is in Appendix B-5. Less detailed summaries are on the bottom label of the modem case and in the Quick-Reference card.

The information in this chapter applies to asynchronous connections only. For synchronous operations, refer to Chapter 7.

## BEFORE CONNECTING

Before two modems can exchange data, they must be set to the same operating conditions. Some settings define how the modems themselves can "talk to each other" on the phone link. Other settings are "end to end" and are determined by the terminal or the computer's software, that is, by the DTEs. For a successful call, you need to know some things about the remote system's requirements.

### Modulation/ Standards

The remote modem must be compatible in its modulation and standard operating procedures. Your Courier modem adheres to some, if not all, of the following modulation and signaling standards, as noted.

| Bits per Second | Standard | Courier Model |
|---|---|---|
| 14.4K | USR-HST | Courier HST Dual Standard<br>Courier HST |
| 9600 | USR-HST | Courier HST Dual Standard<br>Courier HST |
| 9600 | V.32 | Courier HST Dual Standard<br>Courier V.32 |
| 2400 | V.22*bis* | All models |
| 1200 | Bell 212A or CCITT V.22 | All models |
| 300 | Bell 103 or CCITT V.21 | All models |

NOTE: If you have trouble connecting in V.32 mode, you may need to modify the duration of the answer sequence by lengthening or shortening the default value of S-register 28. For details, see S28 in Appendix B-5.

### Setting the Transmission Rate

Set your terminal or software to 38.4K, 19.2K or 9600 bps and, unless you have special requirements, leave the modem at its link operation factory setting, &NØ. &NØ allows the modem to automatically adjust to the rate of the remote modem.

If the modem is set to &BØ, your terminal or computer will also switch rates. If the modem is set to &B1, for a fixed higher rate at the terminal or computer interface, be sure to

follow the directions for the &B, flow control, and data rate commands in Chapter 4.

### Data Format

Both modems must use the same 10-bit data format. The formats allowed are as follows:

| Start Bits | Word Length | Parity | Stop Bits |
|---|---|---|---|
| 1 | 7 | Even, Odd, Mark, Space | 1 |
| 1 | 7 | None, Even, Odd, Mark, Space | 2 |
| 1 | 8 | None | 1, 2 |

### Error Control

In a few rare instances, it may be necessary to disable error control at high speeds (14.4K or 9600 bps). However, to maintain reliable data, we recommend that you always set the Courier for error control, &M4 (the default) or &M5, for calls above 2400 bps. Of course, many users communicating with MNP-compatible modems will want error control at 2400 and 1200 bps as well.

It is a good idea to find out if the remote modem is MNP-compatible at 2400 or 1200 bps. Some public network services, for example, are not. If the Courier is set to &M4 and dials a modem that is not under error control, it operates in Normal mode (no error control). However, if the remote modem doesn't support the MNP protocol at 2400 or 1200 bps, the error control request signals may be misinterpreted and block a successful connection. If you know the remote modem doesn't support MNP, set the Courier to &MØ before dialing.

### Automatic Retrain

An HST or V.22*bis* modem sends a retrain signal if it senses that a problem in the phone link may be causing data errors. The modems stop the transfer of data for about a second while they resynchronize, and then resume Data mode operation. The Modem Ready LED flashes when retraining occurs. For details, see Appendix E-3.

## PLACING CALLS

The commands discussed in this section are used in the following operations:

| | |
|---|---|
| Dialing | D (0-9 # * , ; ! P T W @ R), DS*n* |
| Redialing | A/, A>, > |
| Canceling dialing | <any key> |

### Dial (D)

When the Dial command is issued the modem goes off hook—the equivalent of you picking up the phone—then enters Originate mode and dials the number sequence that follows. The modem also executes any other commands or options included in the command line.

The command string may include up to 40 characters. The modem counts, but ignores punctuation characters such as parentheses and hyphens. It does not count spaces, the AT prefix or the Carriage Return (Enter key) required to execute the command.

The following command instructs the modem to stop the display of commands (E0, turn off the local echo), to dial (D) the phone number (1234567) using Touch-Tone dialing (T), and to turn off the speaker (M0). The spaces shown are ignored by the modem and are only included here for readability.

```
AT E0 DT 1234567 M0 <Enter>
```

### *Dialing Type, Pulse or Tone*

If set to X0 or X1, the modem defaults to pulse (rotary) dialing. To have the modem use tone dialing, use the T command, which also allows you to use the asterisk (*) and pound sign (#). The command may be included in the Dial string, as in the above example, or issued separately:

```
ATT <Enter>
```

The following command resets the modem to pulse dialing:

```
ATP <Enter>
```

You can switch from one dial type to another within a dialing sequence.

NOTE: The modem remains set to the dialing type of the last call until it is reset (ATZ command) or it receives a different dial-type command.

### *Adaptive Dialing (X2–X7)*

When any of the X2 through X7 options is in effect and you do not issue a dialing type in the Dial string, the Courier uses tone dialing, which is faster than the default pulse type. However, if the phone company's central office does not have Touch-Tone detection equipment, the modem cannot *break dial* and continues to detect the dial tone. If this occurs, the modem automatically reverts to pulse dialing.

*Pause (,)*

A comma causes a two-second delay in the dial sequence. The following example contains four-second delays at several points:

ATDP 9,,7654321,,T 55555,,1 312 1234567 <Enter>

The first four-second pause is to access an outside line after dialing 9, the second to make sure the remote computer is ready for the user's account number, and the third, to delay before dialing the long-distance number.

Such pauses, however, may not be necessary. Experiment and use delays only as required. In addition, see the W option, below.

*Slash (/)*

A slash (/) can be used in any command string to have the modem pause for only 125 milliseconds. Some users find the shorter delay of a series of slashes, rather than the 2-second comma pause, useful for certain applications.

*Wait for Another Dial Tone (W)*

This command is useful in situations where you must wait for a second dial tone before continuing dialing. For example, if you need to dial an outside line, as in the following example, the Courier continues dialing as soon as it detects the next dial tone.

ATD9W1234567 <Enter>

NOTE: This command executes only if result code option X3 or greater has been issued. If the modem is set to X2 or lower, the modem interprets the W as a comma (two-second pause).

*Dial and Return to Command Mode (;)*

If your phone is plugged into the modem, you can use this option to have the modem Auto Dial a telephone rather than a modem. The Courier dials, remains off hook and returns the OK message, indicating it is in Command mode.

For example, to have the modem place a voice call, enter the Dial command with a semicolon:

ATDT5551234; <Enter>

When the modem returns the OK result, pick up your phone receiver so you can talk to the other party and tell the modem to hang up:

ATH <Enter>

Similarly, you can call a recorded weather or other service. Have the modem Dial, listen to the recording over the modem's speaker and, when you are finished, tell the modem to hang up.

*Dialing Letters (")*

Quotation marks are used to have the modem dial abbreviations and acronyms used as phone "numbers," such as DIAL USR (the USRobotics Sales Department's 800 number). The option is called Quote mode. Quotation marks are inserted at the beginning of the alphabetic string:

ATDT"BBS NEWS <Enter>

NOTE: If you are including another command after the dial string, use closing quotation marks before the additional command.

*Transferring Calls (!)*

This command applies to modems in installations where other modems share the phone line. The modem flashes the switch-hook, i.e., goes off hook 0.5 seconds, on hook for 0.5 seconds, and off hook again to dial the specified extension. The following example includes instructions to return to Command mode (;) and to hang up (H).

ATDT !1234;H <Enter>

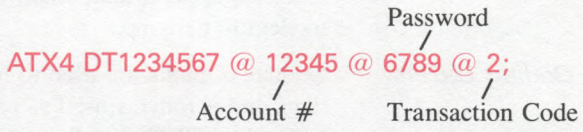
*Wait for an Answer (@)*

Some online services answer the phone and return a tape-recorded request for information before processing transactions. In such instances, the @ command can be used in the Dial string to tell the modem to detect at least one ring, wait for five seconds of silence at the other end of the call, and then continue to execute the Dial string.

To use the @ command, set the modem to X3, X4 or X7. If the modem is set to X2 or lower, the modem returns an ERROR message when encountering the @ character in a command string. If set to X5 or X6, the modem hangs up when it detects a voice answer and sends the VOICE result code.

In the next example, the modem is set to the X4 result code option and dials a banking service. Each occurrence of @ in the example indicates a five-second wait for silence after taped requests from the bank for the labeled items. The

transaction code might be used, for example, to request an account balance.




If the necessary conditions do not occur—no rings, or no following five seconds of silence—the modem times out as it normally would (after 60 seconds). It then sends the message NO ANSWER to the screen and aborts the command.

*Reversing Originate/Answer Frequencies (R)*

This command allows calls to an originate-only modem. It reverses the modem's originate/answer frequencies, forcing the Courier to dial out at the answer frequency. The command follows the Dial command, before or after the phone number:

```
AT D1234567R <Enter>
AT DR1234567 <Enter>
```

CANCELING DIALING

To cancel Dial-command execution, press <any key>. If you inadvertently hit a key on the keyboard while the modem is dialing, the call is canceled. If this occurs, type the A/ command explained in the next section.

REDIALING

The most frequent reason for redialing is receipt of a busy signal. The Courier provides three ways to redial, as follows.

Re-execute the Last Command (A/)

The A/ command, which does not take the AT prefix or a Carriage Return, redials one time:

```
A/
```

When the modem receives a command, it stores the instruction in its command buffer until it receives the next AT command. Note that if you've sent the modem an additional command since the Dial command, A/ re-executes that command instead of redialing.

Automated Redialing (>, A>)

These two commands, while they can be used to continuously repeat any command, are designed for automated redialing. The first (>) is included in the Dial command. The second (A>) is used alone to continuously redial the command string in the buffer.

*Continuous Repeat (>)*

If you know the modem you are calling is frequently busy, include the Repeat command in the Dial string, as follows:

```
AT > DT 1234567 <Enter>
AT DT 1234567 > <Enter>
```

The modem enters Repeat mode, dials the number, waits the default 60 seconds for a carrier, and hangs up. Then, after a two-second pause, it redials.

The cycle continues until the modems connect or the modem reaches a maximum of 10 attempts. The 10-try limit is mandated by the Canadian Department of Communications (DOC) to prevent tying up local telephone company exchanges with unconnected calls.

*Continuous Re-execute (A>)*

This command combines the features of both the A/ and > commands. The modem enters Repeat mode as described above, and redials the Dial string in the command buffer. Like the A/ command, A> does not take the AT prefix or a Carriage Return:

```
A>
```

*Exiting Repeat Mode*

Should you use > or A> with a command other than a Dial string, abort the cycle by pressing <any key>.

To abort automated redialing, be sure to press <any key> when the result code appears, during the pause before the modem begins dialing again. If you press <any key> while the modem is dialing, that dial attempt is canceled but the cycle continues.

## DIALING A STORED NUMBER (DS*n*)

Chapter 5 includes instructions for storing up to four telephone numbers in nonvolatile random access memory (NRAM). To have the modem dial a stored number use the DS*n* command, where *n* is the number's position, Ø–3, in NRAM. In the first of the next two examples, the phone number is stored at position Ø, assumed by the modem if there is no numeric parameter:

```
ATDS <Enter>
ATDS3 <Enter>
```

If you've stored a long distance service number/access code, for example at position 1, use the DS*n* command to dial the number and code, and follow that with a Dial command to

dial the call's destination. (The spaces are included for readability.)

AT DS1 D 312 5556789 <Enter>

**ESCAPE CODE OPERATIONS (+++)**

Once the modem is online to another system, the only command it recognizes is an escape code of three pluses, which forces the modem back to Command mode. Do the following when issuing the command:

- Wait one second after sending the last item of data
- Type: +++
- Wait one second before typing any data

Do not type the AT prefix or a Carriage Return. The guard time of one second before and after the code prevents the modem from misinterpreting the occurrence of +++ in the transmitted data stream.

If necessary, the character used in the escape code or the duration of the guard time can be changed by resetting S-register 2 or 12. See Appendix B-5.

**Modem Response to +++**

The modem returns to Command mode when it detects the escape code. However, it keeps the line open or hangs up, depending on the setting of DIP switch 9:

| DIP Switch 9 | Response to +++ |
|---|---|
| UP | Modem goes on hook (hangs up), sends NO CARRIER result code |
| DOWN | Modem maintains connection, sends OK result code (factory setting) |

Retain the factory-set position (DIP switch 9 DOWN) if you want the modem to execute commands and return online. (See the O command, below.)

If you want an automatic disconnect when you issue +++, set switch 9 UP. (If the modem is on, also issue the ATZ command.) An advantage of this is that you are not likely to inadvertently run up an all-night phone bill.

**WARNING**

For unattended modem operations: in rare instances, the modem may fail to recognize the +++ escape code sequence. If you are running the modem under software control for unattended operations, we suggest you use the surefire method of *dropping the RS-232C DTR signal for at least 50 milliseconds*, to ensure against costly phone charges.

Methods of turning the DTR signal off—for example, closing the communications port—differ from one computer to another.

### RETURNING ONLINE (O)

If DIP switch 9 is DOWN (on detection of the escape code the modem maintains the connection), you can issue commands and then toggle the modem back online with the O command, as in this example:

```
AT Q1 O <Enter>
```

### HANGING UP (H*n*)

If DIP switch 9 is DOWN (factory setting), the escape code forces the modem back to Command mode but leaves the line open. To instruct the modem to hang up, issue the following command once the modem sends the OK result code:

```
ATH <Enter>
```

If DIP switch 9 is UP, the modem automatically hangs up on receipt of the escape code.

### AUTOMATIC ANSWERING

The Courier is shipped with DIP switch 5 DOWN, Auto Answer suppressed. To set the modem to automatically answer incoming calls, do one of the following:

1. Before powering on the modem, set DIP switch 5 UP. When you turn the modem on, it answers incoming calls on the first ring.
2. If the modem is on, use software control. The following command instructs the modem to answer on the first ring. (You can substitute a higher value. See the S-Register summary in Appendix B-5.)

```
ATS0=1 <Enter>
```

When the modem senses a call coming in, it sends the result code RING to your screen, goes off hook, and sends the remote modem a high-pitched answer tone. If there is no Carrier Detect within 60 seconds, the modem hangs up. If the connection is made, the modem sends a CONNECT result code. When the call is disconnected by you or the remote user, the modem hangs up and returns the NO CARRIER code.

### Suppressing Auto Answer

To disable Auto Answer, reverse steps 1 or 2 above. Set DIP switch 5 DOWN before powering on the modem or, if it is powered on, use the command to set the modem to answer on zero rings:

ATS0=0 <Enter>

### Points to Remember

1. If the modem is attached to a computer, you can set the modem to receive calls when you're not there. Load your communications software as you normally do, and set the modem to Auto Answer. Also set your software's file-save function to save incoming messages and/or files.

2. If you've attached your phone so it can be used for conventional calls, disable Auto Answer when you are not expecting incoming data calls. Otherwise, your modem may answer the phone before you do, greeting a voice caller with a high-pitched, irritating answer tone.

## INTERNATIONAL CALLS

Three commands enable international calls. Except in the case of the B*n* command, which is also used to select HST or V.32 operation, these commands only apply when you want the Courier to *answer calls* that originate outside of the U.S. or Canada.

### Handshaking Options (B*n*)

This command is used primarily to select HST or V.32 operations. The B0 setting is always required for V.32 operation. The B1 setting is normally required for HST operation, unless you are expecting a call from overseas, as described under B0.

#### *B0*

This is the required setting for V.32 operation. It also selects the CCITT V.25 answer sequence, used outside of North America, consisting of a 2100 Hz tone followed by a 2250 Hz tone. This answer sequence is incorporated into the V.32 recommendation.

This setting is the default for the Courier V.32. All you need to do is make sure the modem is set for Auto Answer (ATS0=0).

Other Courier models in HST mode (B1) can answer an international call if they are set to B0. Just be sure, if you also have V.32 capability, to set S-register 28 to zero to dis-

able V.32 operation. The following command example sets the modem to Auto Answer and to the CCITT answer sequence, and disables V.32 mode:

ATS0=0 B0 S28=0 <Enter>

The CCITT answer sequence does not affect the modem's ability to call or answer a domestic modem. It will take slightly longer, however, to answer a calling modem.

*B1* This is the required setting for HST-mode operation. It also selects the Bell 2225 Hz answer tone used in the U.S. and Canada. This setting is the default for the Courier HST Dual Standard and Courier HST modems, and always *invalid* for V.32 operations.

Guard Tone (&G*n*) This setting applies only to overseas calls at 2400 or 1200 bps. It applies only to Courier HST Dual Standard and Courier HST modems.

British phone switching systems require the modem to send an 1800 Hz guard tone after it sends an answer tone. Some other European phone networks require a 550 Hz guard tone. Guard tones are not used in the United States or Canada.

*&G0* No guard tone, U.S./Canada. Default.

*&G1* 550 Hz guard tone follows answer tone.

*&G2* 1800 Hz guard tone follows answer tone, United Kingdom and some Commonwealth countries. Requires B0 setting.

Pulse Dial Make/ Break Ratio (&P*n*) This command sets the ratio of the off-hook/on-hook (make/ break) interval for pulse (rotary) dialing. The default sets the modem for use in North America. The ratio must be changed if the modem is used in the United Kingdom and some Commonwealth countries.

*&P0* Make/break ratio, U.S./Canada: 39%/61%. Default.

*&P1* Make/break ratio, United Kingdom, some Commonwealth countries: 33%/67%.

NOTE: To call or answer overseas modems at 300 bps, set the modem to CCITT V.21 mode. See S27 in Appendix B-5.

## OVERVIEW

Synchronous mode is required for some users who need to call, or receive calls from, a *Host* computer of a large network. The Host is usually a mainframe. The user's device is called a terminal, even if it is a powerful personal computer.

### *Data Rate Synchronization*

During synchronous operations, transmit and receive clocks at both ends of the link control the precise timing of the data flow. The communications port at the mainframe (the modem and network software) and your modem and DTE must all handle the data for your call at the same speed.

### *Protocol Compatibility*

The devices that format the data at both ends of the link must also use the same protocol. The link protocol may be SDLC (Synchronous Data Link Control), HDLC (High-Level Data Link Control), BISYNC (Binary Synchronous Control) or another protocol determined by the mainframe manufacturer. These protocols format the data into blocks or frames, add control information, and usually provide error control.

If you would like to know more about how these protocols work, review *Error Detection/Retransmission* in Appendix A. The appendix describes the HST/MNP protocol, which operates on the same principles as the synchronous protocols. The main difference is that Courier modems do the HST/MNP formatting. Under synchronous protocols, software does the formatting before the data gets to the modem.

## REQUIREMENTS

Courier modems in *asynchronous* mode adapt to many conditions of remote asynchronous modems. But a mainframe requires strict adherence to specific operating parameters. If you are operating a terminal (not a personal computer) designed for a particular network, you probably need only set the Courier properly before calling or answering.

If you have a personal computer, however, you must find out what hardware and software you need before setting the Courier for synchronous calls.

### What You Need to Know

The network's communications management staff can supply information on the following requirements:

- The protocol needed for your calls
- The software support needed to log into the network, for example, a specific communications package or interface board
- Whether you need to change the duration of the modem's Request to Send/Clear to Send (RTS/CTS) delay. By default, the modem waits 10 milliseconds before responding with its CTS signal after receiving an RTS signal from the DTE.

  If it's necessary to change the duration of the RTS/CTS delay, you'll need to reset S-register 26. See Appendix B-5.
- The phone number, if you will be calling instead of answering
- Any restrictions about when you can call

### The RS232C Interface

Transmit and Receive synchronous timing pins are required at this interface. You'll need either pin 15 or pin 24 for Transmitter timing signals, depending on whether the modem (pin 15) or the DTE (pin 24) generates the signals. You'll also need pin 17, for Receiver timing signals. If you're using an interface adapter, the adapter will implement these pins. If you're building your own cable, review Appendix B-1.

In addition, review the &X options under *Setting the Modem* in this chapter. The &X command is used to select the synchronous timing source.

### The Synchronous Adapter Card

Most personal computers do not support synchronous operations. You will probably have to purchase and install a synchronous adapter card. These cards are multifunction boards that provide the following functions:

- A synchronous port from the DTE to the modem.
- One or more synchronous protocols. Be sure to find out which protocol the Host mainframe requires *before you purchase an adapter.*

- Additional software functions. For example, you need to identify the type of computer or terminal you are using to the mainframe software. You will most likely also have to specify your application, that is, identify the mainframe resources you want to use.

## SETTING THE MODEM

The modem does not recognize commands in synchronous mode. Before attempting to connect with a synchronous network send the following settings to the modem in asynchronous mode.

These settings are explained in more detail in other sections of this manual.

*High Speed Modulation (Bn)*

If your call will be above 2400 bps and you have a Courier HST Dual Standard, you'll need to set the modem either for HST mode (B1) or V.32 mode (BØ).

*Data Rate (&Bn, &Nn)*

If your modem is dialing out, it dials at its current link rate. If your modem is answering, it switches link rates to match the remote modem. Once the modems at both ends of the link are in synchronous mode, they and their respective DTEs will be synchronous. It doesn't matter whether your modem is set for a variable or fixed DTE rate (&BØ or &B1).

For most applications, the modem will require a variable link rate (&NØ). However, if you want to force a connection at a specific link rate, set the modem to &N1 or higher. For example, to force a 1200 bps call, select &N2.

*Flow Control (&Hn, &In, &Rn)*

Only the following Courier settings are allowed: &HØ or &H1, &IØ, &RØ or &R1.

*Transmit Clock Source (Xn)*

This setting specifies whether the Courier or your DTE generates the Transmit clock timing signals for a synchronous call. Most users will require the default setting, &XØ.

*&XØ*

The Courier is the source of the Transmit clock timing signals and sends them to your DTE over the RS-232C interface. Default.

*&X1*

The DTE is the source of the Transmit clock timing signals and sends them to the Courier over the RS-232C interface. This setting is used typically in leased line multiplexed operations. (Multiplexors divide the phone channel so that the channel carries several calls at the same time.)

*&X2*

The Courier's Receiver clock is the source of the timing signals. The signals are looped to the Transmit clock and sent to your DTE over the RS-232C interface. This setting is only used in those systems that require synchronization of data flowing in both directions.

This setting may be used for V.32-mode connections (Courier set to B0). It may also be used for HST-mode connections but only for V.22*bis* calls, that is, at 2400 bps with or without automatic link negotiation fallback to 1200 bps. The reason is that asymmetrical modulation at higher speeds won't work with this setting.

*Synchronous Mode Options (&Mn)*

WARNING: Set DIP switch 1 UP to disable the DTR override. The Data Terminal Ready (DTR) override must be OFF so that the modem detects when the DTE raises and lowers the DTR signal.

Your selection between the two synchronous modes depends on your application(s).

*&M1*

This setting is for synchronous mode and allows you to send dial commands. To have the modem Auto Answer incoming calls, set DIP switch 5 UP before powering on the modem, or send the modem the ATS0=1 command.

The Courier remains in asynchronous Command mode until it connects with a remote modem. Upon connection, the Courier enters synchronous mode and sends synchronous timing signals to your DTE. The Courier does not respond to commands until it returns to Command mode.

**Dialing Out:** Be sure you have set the modem correctly for a synchronous call, including this setting. Then send the modem a Dial command.

**Answering:** When the modem is set correctly, it responds to an incoming synchronous call.

**Hanging Up:** The modem remains online until the remote modem disconnects or your software causes the DTE to drop DTR. The Courier sends the NO CARRIER result code if result codes are enabled, and returns to asynchronous Command mode.

*&M3*

At this setting, the Courier immediately enters continuous synchronous mode. Use this setting if your modem is to be used, permanently or for a lengthy duration, to automatically dial or answer a single synchronous resource.

The modem does not recognize any commands, but will dial the phone number stored in nonvolatile memory (NRAM) at position Ø when the DTE raises the DTR signal. You need to store the phone number: see the &Z*n*=*s* command in Chapter 5. You also must enable bit 3 of S-register 13 (ATS13=8).

The modem will also automatically answer calls. Set DIP switch 5 UP before powering on the modem, or send the modem the ATSØ=1 command.

NOTE: With this setting, it is very important that you set the modem to all of the necessary settings before setting it to &M3. Once the modem is in &M3 mode, it cannot respond to additional commands.

**Dialing Out:** The Courier dials the number stored in nonvolatile memory (NRAM) at position Ø when your software causes your DTE to send the modem a DTR signal.

**Answering:** The Courier automatically answers synchronous calls.

**Hanging Up:** The modem remains online until the remote modem disconnects or your software causes the DTE to drop DTR. The Courier sends the NO CARRIER result code if result codes are enabled, and remains in synchronous mode, ready to dial the stored phone number or answer a call.

*Disabling &M3 Mode*

The only way to disable continuous synchronous mode is to first power the modem off. Unless you have written the &M3 setting to NRAM, power the modem back on to reset the modem to its defaults.

If you've written the &M3 setting to NRAM, make sure DIP switch 10 is DOWN before powering on the modem. This resets the Courier to its factory settings. Then, if you wish, send a different &M setting to NRAM. The new &M setting becomes the current setting. In addition, if DIP switch 10 is UP, the modem loads the new NRAM defaults each time you power on the modem.

### *Additional Terminology*

You may need to know the meanings of the following terms.

*Remote Job Entry (RJE):* This identifies you as a remote user who needs the mainframe to process information. Your *job* may be data entry or a request for information processing.

*Primary/Secondary:* Your system is considered a secondary station. Hosts are primary stations whose software controls incoming and outgoing calls.

## USER INQUIRIES (I*n*)

The Inquiry command has eight options. The most commonly used options display the following information:

| | |
|---|---|
| ATI3 | Call duration |
| ATI4 | Current settings |
| ATI5 | NRAM settings |
| ATI6 | Link diagnostics summary |

**I0** The modem returns a 3-digit product code. If you have a problem and call USRobotics' Technical Support Department, you may be asked for this product code.

**I1** The modem performs a checksum of its read only memory (ROM) and returns the result to the screen. This function is used only in factory testing. The modem should always read the same number.

**I2** The modem performs a test of its random access memory (RAM) and returns either the OK (0) or ERROR (4) result code, followed by OK when the test is completed. You may want to use this command as a checkpoint if the modem appears to be malfunctioning.

**I3** The modem returns the duration of the last call if set to K0. It displays the actual time if set to K1. See the description of the K*n* command in Chapter 5.

**I4** The modem displays its current configuration. The following illustration is an example.

```
USR High Speed Modems (HST, Dual Standard, V.32)

 Settings...

   B1  C1  E1  F1  M1  Q0  V1  X1
   BAUD=9600    PARITY=N  WORDLEN=8
   DIAL=PULSE   ON HOOK   TIMER

   &A1  &B0  &G0  &H0  &I5  &J0  &K1  &L0
   &M4  &N3  &P0  &R1  &S0  &X1  &Y1

   S00=001  S01=000  S02=043  S03=013
   S04=010  S05=008  S06=002  S07=060
   S08=002  S09=006  S10=007  S11=070
   S12=050  S13=000  S14=000  S15=000
   S16=000  S17=000  S18=000  S19=000
   S20=000  S21=010  S22=017  S23=019
   S24=000  S25=000  S26=000  S27=000
   S28=000  S38=000
```

**Figure 8.1—Sample Result of ATI4 Command**

*I5* The modem displays the configuration stored in nonvolatile random access memory (NRAM).

```
USR High Speed Modems (HST, Dual Standard, V.32)

 NRAM Settings...

   DIAL=PULSE  B1  F1  M1  X1
   BAUD=9600   PARITY=N  WORDLEN=8

   &A1  &B0  &G0  &H0  &I5  &J0  &K1  &L0
   &M4  &N3  &P0  &R1  &S0  &X1  &Y1

   S02=043  S03=013  S04=010  S05=008
   S06=002  S07=060  S08=002  S09=006
   S10=007  S11=070  S12=050  S13=000
   S15=000  S19=000  S21=010  S22=017
   S23=019  S24=000  S26=000  S27=000
   S28=000  S38=000

   STORED PHONE #0:
              #1:
              #2:
              #3:
```

**Figure 8.2—Sample NRAM Settings Screen**

*I6* During a connection, the modem monitors and stores information about link operations. When the call is ended, you can request a diagnostic summary, as in the following example.

```
USR High Speed Modems (HST, Dual Standard, V.32)

Link Diagnostics...

Chars sent                3     Chars Received          1200
Chars lost                0
Octets sent               3     Octets Received          691
Blocks sent               2     Blocks Received          123
Blocks resent             0

Retrains Requested        0     Retrains Granted           0
Line Reversals            0     Blers                      0
Link Timeouts             0     Link Naks                  0

Data Compression      On
Equalization          Long
Fallback              Enabled

Disconnect Reason is User Hung Up
```

**Figure 8.3—Sample Link Diagnostics Screen (ATI6)**

Terms used in the display are self-explanatory except for the following:

| | |
|---|---|
| Octets | Compressed characters |
| Blers | Errors in protocol (non-data) blocks |
| Link Naks | Negative acknowledgments (one or more blocks) |
| Link Timeouts | Protocol operations, not the retry timeout; used in internal testing |
| Data Compression | On/Off: indicates if data compression was negotiated for the call |
| Equalization | Long/Short: status of S15 bit Ø; long if bit Ø = Ø, short if bit Ø = 1 |
| Fallback | Enabled/Disabled: indicates whether or not the modems negotiated online fallback during the connection sequence |

*I7* The modem returns a product configuration. If you have a problem and call USRobotics' Technical Support, you may be asked to read this screen.

**S-REGISTER QUERY (S*r*?)** This command allows you to view the contents of a particular S-Register, as in the following example that requests the contents of register SØ ("On what ring will the modem answer?"):

ATSØ ? <Enter>

### PHONE NUMBER QUERY (&Zn?)

At this command, the modem returns the phone number stored in NRAM at position *n*, as in the following example that includes a sample modem response:

```
AT&Z3? <Enter>
5551234
```

### HELP SCREENS

Courier modems provide four Help screens: summaries of the basic AT command set, extended ampersand (&) command set, S-register functions, and Dial command options.

### *Stop/Restart Display*

The following command stops the display. Hold down the Control key and type "S":

```
<Ctrl>-S
```

To restart the display, use the same command or press <any key>.

### *Cancel Display*

Either of the following commands cancels the display.

```
<Ctrl>-C
<Ctrl>-K
```

### Basic Command Set ($)

At AT$, the Courier displays this command set summary:

```
HELP,  Command Quick Reference (CTRL-S to Stop, CTRL-C to Cancel)

A$    HELP, Extended Commands          In    n=0  Product Code
A     Answer Call                            n=1  Checksum
A/    Repeat Last Command                    n=2  RAM Test
A>    Continuously Repeat Command            n=3  Call Duration/Clock
Bn    n=0  V.32 Mode/CCITT Mode              n=4  Current Settings
      n=1  HST Mode/Bell Answer Seq          n=5  NRAM Settings
Cn    n=0  Transmitter Off                   n=6  Link Diagnostics
      n=1  Transmitter On                    n=7  Product Configuration
Dn    Dial a Telephone Number          Kn    n=0  Call Duration Mode
      n=0..9#*TPR,;"W@!()-                   n=1  Real Time Clock Mode
DSn   Dial Stored Phone Number         Mn    n=0  Speaker Off
D$    HELP, Dial Commands                     n=1  Speaker On Until CD
En    n=0  No Command Echo                    n=2  Speaker Always On
      n=1  Echo Command Chars                 n=3  Speaker Off During Dial
Fn    n=0  Online Echo                 O     Return On-Line
      n=1  No Online Echo              P     Pulse dial
Hn    n=0  On Hook (Hang Up)           Qn    n=0  Result Codes Sent
      n=1  Off Hook                          n=1  Quiet (No Result Codes)
Strike a key when ready . . .
```

**Figure 8.4—Basic Commands HELP Screen**

## Extended Command Set (&$)

At AT&$, the Courier displays this summary of the extended ampersand command set:

```
HELP, Extended Commands (CTRL-S to Stop, CTRL-C to Cancel)

&An   n=0  Disable /ARQ Result Codes
      n=1  Enable /ARQ Result Codes
&Bn   n=0  Variable DTE Speed
      n=1  Fixed DTE Speed
      n=2  DTE Rate Fixed When ARQ
&F    Load Factory Configuration
&Gn   n=0  No Guard Tone
      n=1  550 Hz Guard Tone
      n=2  1800 Hz Guard Tone
&Hn   n=0  Disable TX Data Flow Control
      n=1  CTS
      n=2  Xon/Xoff
      n=3  CTS and Xon/Xoff
&In   n=0  Disable RX Data Flow Control
      n=1  Xon/Xoff
      n=2  Xon/Xoff Chars Filtered
      n=3  HP Host Mode
      n=4  HP Terminal Mode
      n=5  Xon/Xoff For Non-ARQ Mode
      n=6  HP Host Mode, Local
      n=7  HP Terminal Mode, Local

&Jn   n=0  RJ11 Jack
      n=1  RJ12/13 Jack
&Kn   n=0  Disable Data Compression
      n=1  Auto Data Compression
      n=2  Enable Data Compression
&Ln   n=0  Disable Leased Line
      n=1  Enable Leased Line
&Mn   n=0  Normal Mode
      n=1  Smart/Synchronous Mode
      n=2  Reserved
      n=3  Synchronous Only
      n=4  ARQ/Normal Mode
      n=5  ARQ Mode
&Nn   n=0  Highest Link Speed
      n=1  300 bps
      n=2  1200 bps
      n=3  2400 bps
      n=4  4800 bps
      n=5  7200 bps
      n=6  9600 bps
      n=7  12000 bps
      n=8  14400 bps

Strike a key when ready . . .
```

**Figure 8.5—Ampersand Commands HELP Screen**

## Dialing (D$)

At ATD$, the Courier displays this Dial command summary:

```
HELP, Dial Commands (CTRL-S to Stop, CTRL-C to Cancel)

0-9 Digits to Dial
*   Auxiliary Dial Digit
#   Auxiliary Dial Digit
T   Tone Dialing
P   Pulse Dialing
R   Call an Originate Only Modem
,   Pause (Wait for S8 Time)
;   Remain in Command Mode after Dialing
"   Used to Dial Alpha Phone #'s
W   Wait for 2nd Dial Tone (X3-X7)
@   Wait for an Answer (X3-X7)
!   Flash Switch Hook
```

**Figure 8.6—Dial Command HELP Screen**

### S-Register Functions (S$)

At ATS$, the Courier displays a summary of the S-register functions:

```
HELP, S Register Functions (CTRL-S to Stop, CTRL-C to Cancel)

S0  Ring to Answer On                  S16 Test Modes
S1  Counts 8 of Rings                        1 = Analog Loopback
S2  Escape Code Char                         2 = Dial Test
S3  Carriage Return Char                     4 = Test Pattern
S4  Line Feed Char                           8 = Remote Digital Loopback
S5  Backspace Char                          16 = Reserved
S6  Wait Time/Dial Tone (sec)               32 = Reserved
S7  Wait Time/Carrier (sec)                 64 = Reserved
S8  Comma and Repeat Pause (sec)           128 = Reserved
S9  Carrier Detect Time (1/10sec)      S17 Reserved
S10 Carrier Loss Time (1/10sec)        S18 Reserved
S11 Touch Tone Spacing (msec)          S19 Inactivity Timeout (min)
S12 Escape Code Time (1/50sec)         S20 Reserved
S13 Bit Mapped                         S21 Break Length (1/100sec)
      1 = Reset On DTR loss            S22 Xon Char
      2 = Do Originate in Auto Answer  S23 Xoff Char
      4 = No Pause Before Result Codes S24 DSR Pulse Time (1/100sec)
      8 = Do DS0 On DTR                S25 Reserved
Strike a key when ready . . .
```

**Figure 8.7—S-Register HELP Screen**

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Courier modems use the MNP error control protocol, Service Levels 1–5. MNP was originally developed by Microcom, Inc. and is now in the public domain. In HST-compatible Couriers, the error control procedures for Levels 1–4 have been modified for asymmetrical modulation at the higher speeds of 14.4K, 12K, 9600, 7200 and 4800 bps.

In USRobotics implementations, we use the general term ARQ (automatic repeat request) to denote a connection under error control. Error-free data transmission is ensured through two features:

- error-detection and retransmission techniques;
- data buffering and flow control.

NOTE: As with all protocols, error control only works when the Courier connects with another modem that implements the same protocol.

## MNP LEVEL NEGOTIATION

When the modems negotiate an ARQ connection, they indicate their highest of the first three Service Levels, 3, 2, or 1, and agree to operate at the highest possible level. The Courier indicates Level 3 in its error-control request. If necessary, the Courier drops back to meet the requirements of the other modem. This establishes the error-control (ARQ) connection.

The Courier also requests Levels 4 and 5, which enhance throughput performance. These levels are possible only if an ARQ connection, at one of the first three Service Levels, can also be negotiated. Depending on the Service Level capabilities of the remote modem, the Courier may establish a connection at Level 3, 2, or 1, plus either Level 4 or Level 5, or both.

## Throughput

Chapters 3 and 4 include recommended modem settings and file-transfer guidelines for gaining maximum throughput. The following descriptions of MNP Levels 1–5 include achievable throughput statistics.

### *Level 1*

This level, often called Block Mode, supports half-duplex (one way at a time) transmission. The sending modem transmits a block of data and waits for an acknowledgment from the receiving modem before sending the next.

Level 1 is the slowest and is only included because some computer equipment is restricted to either sending or receiving at any one time. This mode of operation is usually observed in communications between terminals rather than in terminal-to-computer or computer-to-computer links.

*Level 2* This level, often called Stream Mode, supports full-duplex transmission in which data flows in both directions at the same time. Throughput at Level 2, due to protocol overhead, achieves about 84% of the throughput of a normal modem, or approximately 202 characters per second (cps) at 2400 bps.

*Level 3* Level 3 incorporates Level 2 and is more efficient. Modems sending at Level 3 strip the Start and Stop bits from the data characters and transmit the data across the link in a bit stream, as in synchronous transmission, rather than in character format. The receiving modem reinserts the Start and Stop bits for each character before passing the data to the receiving computer or terminal.

This procedure offsets the protocol overhead loss so that throughput is about 108% that of a normal modem. Under optimal conditions, two Level 3 modems operating at 2400 bps can exchange data at approximately 254 characters per second.

*Level 4* At this level, the information in the headers of data blocks is streamlined to eliminate some of the protocol overhead. In addition, the size of the blocks is greater than with Level 3.

The results in characters per second (cps) are as follows. These reflect operations without the data compression available with MNP Level 5.

| | Characters per Second | |
|---|---|---|
| Link Rate | Level 3 | Level 4 |
| 14.4K | 1650 | 1740 |
| 9600 | 1100 | 1160 |
| 2400 | 254 | 276 |

In general, with Level 4 you can expect a throughput gain of 5%, although actual throughput depends on the type of call. Gains on long-link satellite calls can range from 25–50%.

### *Level 5*

Under Level 5 data compression, the sending modem detects redundant units of data and recodes them into shorter units of fewer bits. Examples include the frequent occurrences of spaces, control characters, or the characters *e* and *s* in ASCII text files. The receiving modem decompresses the redundant data units before passing them to the receiving computer/terminal.

With data compression, throughput of up to 38.4K bps is theoretically possible. Typical achievable throughput for different kinds of files, in characters per second (cps), is shown in the following table.

The table assumes the following conditions:

- DTE rate set at 38.4K bps; modem set to &B1
- Connection (link) rate of 14.4K bps
- Level 4 also enabled (longer transmission blocks)
- Straight data (e.g., not already compressed, no file-transfer protocol)
- Transmission from a fast (e.g., 286) computer

| File Type | Throughput (cps) |
|---|---|
| Assembler or Compiler Listing | 2880 |
| Text file | 2325-2625 |
| Binary file: .EXE | 2175-2400 |
| Binary file: .COM | 2100-2250 |
| .ARC files (common on BBS's) | 1500-1650* |
| Random binary 8-bit | 1460-1575* |

* As mentioned in Chapter 4, under *Throughput Guidelines*, these files are already compressed or appear to the modem to be compressed. When they undergo additional data compression, as shown here, throughput actually decreases.

## ERROR DETECTION/ RETRANSMISSION

During an ARQ connection the transmitting modem divides the data it receives from the computer or terminal into blocks, and attaches header and trailer information. The result is called a frame, as shown in Figure A.1.

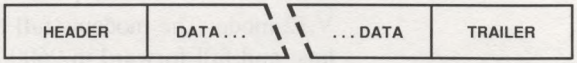


**Figure A.1—Transmission Frame**

Included in the header or trailer are a frame number and block-size information as well as a *frame-check* code. This last code is derived by the sending modem through an algorithm performed on all of the data in the frame. The technique is called *cyclic-redundancy checking (CRC).*

The receiving modem performs the same computation and checks to see if its results match the received CRC code. If the results match, the receiving modem sends a positive acknowledgement to the sending modem. Meanwhile, the sending modem keeps a copy of all frames it sends until each is positively acknowledged.

If the CRC codes don't match, the receiving modem initiates the *automatic repeat request (ARQ)* procedure. The receiving modem tells the sending modem which frame is in error, and doesn't accept any more frames until the frame in question is received correctly. The sending modem goes back to the specified frame, retransmits it, and continues from there. In this way the protocol protects against errors and also ensures that the data arrives in sequence.

### ARQ Retry Timeout

It may happen that a retransmission request for the same frame occurs repeatedly. Ordinarily this is due to a serious disturbance in the phone connection. The retry maximum is 12, after which the modems automatically hang up instead of incurring wasteful phone charges. If the Courier hangs up and you do not know why, use the ATI6 command to display a link diagnostics screen. The screen is illustrated and described in Chapter 8.

### Online Fallback

During high-speed error control connections, as just mentioned, the modems monitor the frequency of retransmitted frames. To avoid the retry timeout, the modems first fall back to a lower transmission rate. As line improvements occur, they fall forward to their next higher rate. Online fallback occurs as follows.

HST mode: The modems fall back successively, only as necessary, within the range from 14.4K bps to 12K/9600/7200/4800 bps. They fall forward to the next higher speed as soon as the reliability of the line improves.

V.32 mode: The modems fall back from 9600 bps to 4800 bps, and fall forward to 9600 bps when the line improves.

Online fallback is designed to keep you online at high speeds despite phone line impairments. This feature has the following characteristics:

- Online fallback has no effect on the DTE rate set with the &B command.
- The link rate must be set to &NØ (variable rates). If set to a fixed link rate (e.g., &N4 or &N6), the modem remains fixed at that rate and online fallback is disabled.
- During retraining down to the next lower speed, the Modem Ready LED flashes. In all other ways, the fallback is transparent to users.
- The modem does not send result codes reflecting the rate changes.
- Online fallback is distinct from the link negotiation fallback that makes Courier modems compatible with most 300/1200/2400-bps modems.

## FLOW CONTROL

The modem stores data from the terminal in its Transmit buffer, and data received from a remote system in its Receive buffer, as shown in Figure A.2.

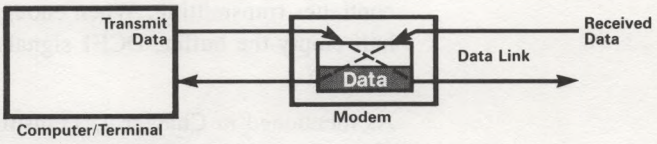


**Figure A.2—Flow Control Buffer**

Separate commands enable Transmit Data flow control (&H*n*) and Received Data flow control (&I*n*, &R*n*). Chapter 4 contains instructions on when and how to use these commands.

### Flow Control Examples

The labels used in the following examples indicate the following devices:

DTE *Data Terminal Equipment:* the computer or terminal to which a modem is attached.

DCE *Data Communications Equipment:* the Courier or remote modem.

Example 1—Transmit Data

The &H*n* command allows you to select software flow control, hardware flow control, or both. Hardware flow control is most reliable and is recommended, if possible. Under hardware control the modem raises or lowers the Clear to Send (CTS) signal at the RS-232C interface. Under software flow control the modem sends the DTE the ASCII XON/XOFF characters described in Chapter 4.

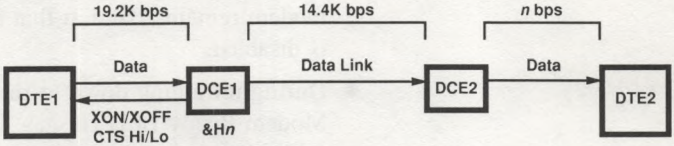


**Figure A.3—Transmit Flow Control**

Assume that there are disturbances on the line (line hits) and DCE2, the receiving modem, detects a transmitted frame in error. DCE2 tells DCE1 to retransmit the frame and accepts no additional frames until it receives the affected frame correctly.

Meanwhile, the computer/terminal (DTE1) continues sending to DCE1, and data backs up in the Transmit buffer. As the buffer approaches capacity, DCE1 signals DTE1 to stop sending data. DCE1 also retransmits the specified frame and continues transmitting. When enough data is transmitted to half empty the buffer, DCE1 signals DTE1 to resume sending data.

As mentioned in Chapter 4, Transmit Data flow control is also essential if the DTE is sending data to the modem at a rate that is higher than the link rate. For example, the DTE may be sending data at 38.4K bps, and the link rate may be 9600 bps.

Example 2—Received Data

It may be necessary or desirable to stop incoming data temporarily, for example, in order to review what's on the screen and take some kind of action. In the following diagram, the labels indicate operations for two of the command options.

&I2 The user sends XON/XOFF commands to DCE1, but the modem doesn't pass them on to the remote computer. As mentioned in Chapter 4, this is the recommended setting, but only for calls under error control, if you can't use hardware control (&R2).

&R2 DTE1 lowers the Request to Send (RTS) signal at the RS-232C interface. This signals DCE1 to stop passing on received data until the DTE raises the RTS signal again.

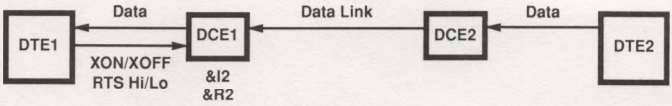


**Figure A.4—Received Data Flow Control**

Be sure to review Chapters 3 and 4 before using the error/flow control commands.

CONTENTS

B-1 The RS-232C Interface, with Pin Definitions
B-2 Front Panel Indicators
B-3 DIP Switch Summary
B-4 Default Settings
B-5 S-Register Summary
B-6 ASCII Chart

# THE RS-232C INTERFACE, WITH PIN DEFINITIONS

## DESCRIPTION

The RS-232C interface (often referred to without the *C*) is a standard developed by the Electronic Industries Association (EIA). It defines the signals and voltages used when data is exchanged between a computer or terminal and a modem or serial printer. Data is transmitted between the devices via a cable with 25-pin, 9-pin or custom-built connectors.

## PIN ASSIGNMENTS

The entire standard covers many more functions than are used in most data communications applications. Pin assignments are factory set in the Courier to match the standard DB-25 assignments in the following table. DB-9 connectors at the computer end of the cable should be wired as shown in the DB-9 column.

### RS-232C INTERFACE PIN DEFINITIONS

| DB-25 | DB-9 | Circuit | Function | Signal Flow DTE ↔ DCE[1] |
|---|---|---|---|---|
| 1 | — | AA | Chassis Ground | ↔ |
| 2 | 3 | BA | Transmitted Data | → |
| 3 | 2 | BB | Received Data | ← |
| 4 | 7 | CA | Request to Send | → |
| 5 | 8 | CB | Clear to Send | ← |
| 6 | 6 | CC | Data Set Ready | ← |
| 7 | 5 | AB | Signal Ground | ↔ |
| 8 | 1 | CF | Carrier Detect | ← |
| 12 | — | SCF | Speed Indicate | ← |
| 15 | — | DB | Synchronous TX[2] Timing | ← |
| 17 | — | DD | Synchronous RX[2] Timing | ← |
| 20 | 4 | CD | Data Terminal Ready | → |
| 22 | 9 | CE | Ring Indicate | ← |
| 24 | — | DA | Synchronous TX[2] Timing | → |

[1]DTE indicates the terminal or computer; DCE indicates the modem.
[2]Indicates Transmitter (TX) or Receiver (RX).

## Minimum Requirements

Some computer/terminal equipment supports only a few of the RS-232C signal functions set in the Courier. The minimum required for the modem to operate are as follows:

*Asynchronous Calls*

| DB-25 Pin | DB-9 Pin | Function |
|---|---|---|
| 2 | 3 | Transmitted Data |
| 3 | 2 | Received Data |
| 7 | 5 | Signal Ground |
| 20 | 4 | Data Terminal Ready* |

*Required only if you have the Data Terminal Ready Override switch OFF (DIP switch 1 UP).

*Synchronous Calls*

You will need all of the above functions as well as pin 15 *or* 24, for Transmitter timing signals, and pin 17 for Receiver timing signals. See Chapter 7 for more detailed information.

Additional Flow Control Functions

If your computer and software support Clear to Send and you wish to use Transmit Data hardware flow control (&H1), Pin 5 (DB-25) or Pin 8 (DB-9) is required.

If your computer and software support Request to Send and you wish to use Received Data hardware flow control (&R2), Pin 4 (DB-25) or Pin 7 (DB-9) is required.

FOR 38.4K DTE RATE

The RS-232C cable should be shielded. Cables are normally six feet long, but longer lengths are possible. If you encounter problems with signal degradation, try a shorter cable.

If you decide to build your own cable, use a low-capacitance cable. To further minimize the capacitance, connect only those functions (pins) that your application requires.

## APPENDIX B-2

## FRONT PANEL INDICATORS

| Symbol | Meaning | Status |
|---|---|---|
| HS | High Speed | All calls above 2400 bps: ON during call progress, after completion of dialing; OFF during HST-mode link negotiations at 2400 bps, then ON during connection. Remains ON after disconnect until next call is originated or answered. |
| AA | Auto Answer/ Answer | Answer mode only: ON when your modem is in Auto Answer mode, and when answering a call; in HST mode, goes OFF if the channel is reversed and your answering modem transmits at 450 or 300 bps. Also goes OFF when the modem originates a call. |
| CD | Carrier Detect | ON when the CD override (DIP switch 6) is ON (DOWN). ON if DIP switch 6 is UP and the Courier receives a valid data signal (carrier) from a remote modem, indicating that data transmission is possible. |
| OH | Off Hook | ON when the Courier takes control of the phone line to establish a data link. |
| RD | Received Data | Flashes when the modem sends result codes or passes received data bits to the terminal or computer. |
| SD | Send Data | Flashes when the terminal or computer sends a data bit to the Courier. |
| TR | Data Terminal Ready | ON when the DTR override (DIP switch 1) is ON (DOWN). ON if DIP switch 1 is UP and the modem receives a DTR signal from the terminal or computer. |
| MR | Modem Ready/ Test Mode | ON when the Courier is powered on. Flashes when the modems retrain, including online fallback, or while the modem is in Test mode. |
| RS | Request to Send | ON when the Courier is powered on if your computer supports RTS. OFF if the Courier is set to &R2 (Received Data hardware flow control) and the computer lowers RTS. |

| Symbol | Meaning | Status |
|---|---|---|
| CS | Clear to Send | ON until the modem lowers CTS when Transmit Data hardware flow control is enabled (&H1, &H3). Always ON during synchronous calls. |
| ARQ | Error Control | Automatic Repeat Request. ON when the Courier is set to &M4 or &M5 and successfully connects with another modem under error control. Flashes when the Courier retransmits data to the remote modem. |
| SYN | Synchronous Mode | ON when the modem is set to &M1 and enters synchronous mode. ON continuously if the modem is set to &M3. |

# DIP SWITCH SUMMARY

## PURPOSE

The Courier's DIP switches, located at the rear of the modem, are for adapting the modem to your equipment and personal requirements. You may also want to experiment and review your computer or terminal documentation as necessary.

Some users are able to move a single switch with a finger tip. If this doesn't work for you, use a toothpick or other small instrument.

## OPERATIONS

The DIP switch settings are power-on defaults, read by the Courier when it is turned on. If changed when the modem is on, switches 2–5, and 9 require the ATZ (software reset) command to initiate the new settings. Switch 8, if set UP to disable command recognition, requires powering off the modem, resetting the switch DOWN, and powering on again to restore command recognition. The remaining (hardware) switches are automatically operative when set UP or DOWN.

### DIP SWITCHES: UP = OFF (OPEN), DOWN = ON (CLOSED)

| Switch | Factory Setting | Function |
|---|---|---|
| 1 | DOWN | Data Terminal Ready (DTR) Operations<br>UP Normal DTR operations: computer must provide DTR signal for modem to accept commands; dropping DTR terminates a call<br>DOWN DTR always ON (Override) |
| 2 | UP | Verbal/Numeric Result Codes<br>UP Verbal (word) results<br>DOWN Numeric results |
| 3 | DOWN | Result Codes Enabled/Suppressed<br>UP Results suppressed<br>DOWN Results enabled |
| 4 | UP | Command Mode Local Echo<br>UP Keyboard commands displayed<br>DOWN Display of commands suppressed |

| Switch | Factory Setting | Function |
|---|---|---|
| 5 | DOWN | Auto Answer<br>UP Modem answers on first ring<br>DOWN Auto answer suppressed |
| 6 | DOWN | Carrier Detect (CD) Operations<br>UP Courier sends CD signal when it connects with another modem, drops CD on disconnect<br>DOWN CD always ON (Override) |
| 7 | UP | Auxiliary Switch<br>UP Result codes displayed in both Originate and Answer modes<br>DOWN Result codes suppressed in Answer mode when DIP switch 3 is DOWN |
| 8 | DOWN | Command Set Recognition<br>UP Recognition disabled (Dumb Mode)<br>DOWN Recognition enabled (Smart Mode) |
| 9 | DOWN | Escape Code (+ + +) Response<br>UP Modem hangs up, returns to Command mode, sends NO CARRIER result<br>DOWN Modem maintains connection, returns to Command mode, sends OK result |
| 10 | UP | Power-on and ATZ Reset Software Defaults<br>UP Load from NRAM<br>DOWN Load factory settings from ROM |
| Quad Switch | UP | RS-232C Modem Terminal Interface<br>UP Normal assignments, see Appendix B-1<br>DOWN Reverse assingments<br>*The need to change this setting is rare. Carefully review your computer or terminal documentation before turning this switch ON.* |

# DEFAULT SETTINGS

## USER-PROGRAMMABLE DEFAULTS

You can create your own default configuration and store it in nonvolatile random access memory (NRAM) using the &W command described in Chapter 5. As long as DIP switch 10 is UP when you power on the modem, your defaults are loaded into the modem's random access memory (RAM). To view your NRAM settings at any time, use the ATI5 command.

Tables on the next two pages list the options you can store in NRAM, including S-Register settings. If DIP switch 10 is DOWN at power on, the factory settings listed in the table are loaded instead. The first time the modem is turned on, the NRAM settings are the same as the factory settings.

The following command example substitutes several user-defined defaults for factory settings. The modem also stores the rate, word length and parity it detects from the AT command prefix.

AT X4 &B1 &M5 &H1 M3 &W <Enter>

| NRAM Options | Factory Setting | |
|---|---|---|
| Error control/Synchronous modes | &M4 | ARQ/non-ARQ mode |
| Data compression | &K1 | Auto enable/disable |
| Error-control result codes | &A1 | Enabled |
| Handshake options[1] | B0/B1 | V.32/HST mode; CCITT/Bell answer mode |
| Transmit data flow control | &H0 | Disabled |
| Received data hardware flow control | &R1 | Ignore RTS |
| Received data software flow control | &I0 | Disabled |
| Data Set Ready (DSR) signal | &S0 | Override |
| DTE rate select | &B0 | Follow connection rate |
| Link rate select | &N0 | Variable link operations |
| Stored telephone number | &Z0–3 = 0 | Blank |
| Tone/Pulse dialing | P | Pulse dial |
| Online local echo | F1 | Echo OFF |
| Speaker control | M1 | ON during dial through connect |
| Result code sets | X1 | Extended |
| Phone line connection | &J0 | RJ11 jack |
| Synchronous Timing Source | &X0 | DCE source |
| Pulse dial make/break ratio | &P0 | U.S./Canada |
| Guard tone | &G0 | U.S./Canada |
| Break handling | &Y1 | Clear buffer, send Break immediately |
| Leased line operation | &L0 | Disabled |
| Computer-to-modem (DTE) Rate[2] | | 9600 bps |
| Word length[2] | | 7 |
| Parity[2] | | Even |

[1] The only valid setting for the Courier V.32 is B0. To connect in HST mode, the Courier HST Dual Standard and Courier HST should be set to B1. An exception is when an HST-mode Courier is to answer an overseas call, in which case, see the B*n* command in the last section of Chapter 6.

[2] During operation, these settings are detected from each AT command. They are determined by how you've set your terminal or communications software before sending a command.

| NRAM S-Register Options | Factory Setting |
|---|---|
| Escape code character, ASCII decimal | S2 = 43 |
| Carriage Return character, ASCII decimal | S3 = 13 |
| Line Feed character, ASCII decimal | S4 = 10 |
| Backspace character, ASCII decimal | S5 = 8 |
| Dial wait-time, sec. | S6 = 2 |
| Carrier wait-time, sec. | S7 = 60 |
| Dial pause/re-execute time, sec. | S8 = 2 |
| Carrier Detect time, 1/10th sec. | S9 = 6 |
| Carrier loss wait-time, 1/10th sec. | S10 = 7 |
| Touch-Tone duration, spacing, msec. | S11 = 70 |
| Escape code guard time, 1/50th sec. | S12 = 50 |
| Bit-mapped functions | S13 = 0 |
| Bit-mapped functions | S15 = 0 |
| Inactivity/hang up timer, min. | S19 = 0 |
| Received break length, 1/100th sec. | S21 = 10 |
| XON character, ASCII decimal | S22 = 17 |
| XOFF character, ASCII decimal | S23 = 19 |
| Pulsed DSR signal-time, 1/100th sec. | S24 = 0 |
| CTS delay after RTS, 1/100th sec. | S26 = 1 |
| Bell 103/V.21 modulation, 300 bps | S27 = 0 |
| Duration, V.32 tones, 1/10th sec | S28 = 8 |
| ARQ mode hang-up delay, sec. | S38 = 0 |

USAGE

The default values are those users typically require. Change the settings with the ATS*r*=*n* command, where *r* is the register and *n* is a decimal value from 0–255:

ATS13=8 <Enter>

The modem does not perform a value-range check. Some values you select may not work with some equipment, and you'll have to readjust the settings.

To display the contents of a register, use ATS*r*? as in this example:

ATS20? <Enter>

| Register | Default | Function |
|---|---|---|
| S0 | See DIP switch 5 | Sets the number of rings on which to answer when in Auto Answer mode. Default=1, equivalent of DIP switch 5 UP. S0=0 or DIP switch 5 DOWN (factory setting) suppresses Auto Answer. |
| S1 | 0 | Counts and stores the number of rings from an incoming call. |
| S2 | 43 | Stores the ASCII decimal code for the escape code character. Default character is "+". A value of 128–255 disables the escape code. |
| S3 | 13 | Stores the ASCII decimal code for the Carriage Return character. |
| S4 | 10 | Stores the ASCII decimal code for the Line Feed character. |
| S5 | 8 | Stores the ASCII decimal code for the Backspace character. A value of 128–255 disables the Backspace key's delete function. |
| S6 | 2 | Sets the number of seconds the modem waits before dialing. If set to X2, X4, X6, or X7, the modem ignores this register and dials as soon as it detects a dial tone (fast dials). |
| S7 | 60 | Sets the number of seconds the modem waits for a carrier. May be set for much longer duration if, for example, the modem is originating an international connection. |
| S8 | 2 | Sets the duration, in seconds, for the pause (,) option in the Dial command and the pause between command re-executions (> and A> commands). |

| Register | Default | Function |
|---|---|---|
| S9 | 6 | Sets the required duration, in tenths of a second, of the remote modem's carrier signal before recognition by the Courier (Carrier Detect Time). The modem ignores this register at speeds above 2400 bps. |
| S10 | 7 | Sets the duration, in tenths of a second, that the modem waits after loss of carrier before hanging up. This guard time allows the modem to distinguish between a line hit, or other disturbance that temporarily breaks the connection, and a true disconnect (hanging up) by the remote modem.<br><br>While we don't recommend connecting the modem to a line with call waiting, should you do so, the Courier may misinterpret the signal for a second call as a disconnect from the remote modem. One solution is to set S10 to a higher value. Better yet, contact your phone company to find out how to temporarily disable call waiting. |
| S11 | 70 | Sets the duration and spacing, in milliseconds, of dialed Touch-Tones. |
| S12 | 50 | Sets the duration, in fiftieths of a second, of the guard time for the escape code sequence. |
| S13 | 0 | Bit-mapped register. Select the bit(s) you want on, and set S13 to the total of the values in the *Value* column. For example, ATS13 = 20 enables bits 2 (value = 4) and 4 (value = 16). |

| Bit | Value | Result |
|---|---|---|
| 0 | 1 | Reset on dropping of DTR |
| 1 | 2 | Reverse normal Auto Answer operation: on incoming RING, enter Originate mode and look for Answer tone |
| 2 | 4 | Disable 250 msec. pause before result code display |
| 3 | 8 | On DTR signal, Auto Dial the number stored in NRAM at position 0 |
| 4 | 16 | At power on/reset, Auto Dial the number stored in NRAM at position 0 |
| 5 | 32 | Reserved |
| 6 | 64 | Disable MNP Level 3 (used for testing Level 2) |
| 7 | 128 | Watchdog hardware reset, same as power on (used in factory testing) |

| Register | Default | Function |
|---|---|---|
| S14 | | Reserved. |
| S15 | 0 | Bit-mapped register. See the instructions for S13, above. |

| Bit | Value | Result |
|---|---|---|
| 0 | 1 | Disable the modem's extra high- frequency equalization if it causes problems on shorter-link calls |
| 1 | 2 | Disable online fallback |
| 2 | 4 | Disable 450-bps back channel, force 300-bps back channel; used in factory testing and to enable the Courier, if set to &M0, to connect with an older 300-bps back channel modem |
| 3 | 8 | Reset non-ARQ mode Transmit buffer from 1.5K bytes to 128 bytes* |
| 4 | 16 | Disable MNP Level 4; retransmitting the larger Level 4 data blocks may be a problem if you expect a great number of errors during a call |
| 5 | 32 | For specialized applications only. May cause software incompatibility in standard applications. |
| 6 | 64 | Some earlier 2400-bps MNP modems, not made by USRobotics or Microcom, were not fully compatible with the MNP protocol. If you have difficulty making a successful 2400-bps MNP connection with a remote MNP modem, it may be because of this incompatibility. Set S15 to 64 and try again to make the connection. |
| 7 | 128 | Enable InterBridge network compatibility |

* The default 1.5K byte non-ARQ buffer allows data transfer with X- and Ymodem-type file transfer protocols without using flow control.

The 128-byte option allows remote users with slower modems to stop data you're transmitting from scrolling off their screens. When remote users send your computer an XOFF (Ctrl-S) and you stop transmitting, the data in transit from your modem's buffer doesn't exceed the size of their screen.

| Register | Default | Function |
|---|---|---|
| S16 | 0 | Modem self-test. See Appendix F for test procedures.<br>0 Data mode (no testing)<br>1 Analog Loopback<br>2 Dial Test<br>4 Test Pattern<br>5 Analog Loopback with Test Pattern<br>8 Remote Digital Loopback (RDL) |
| S17 | | Reserved. |
| S18 | | Reserved. |
| S19 | 0 | Sets the duration, in minutes, for the Inactivity Timer, which is disabled when S19 = 0.<br>When enabled, the timer activates when the modem detects no activity on the phone line. At the timeout the modem hangs up. |
| S20 | | Reserved. |
| S21 | 10 | Sets, in 10-millisecond units, the length of Breaks sent from the modem to the local terminal. Applies to ARQ mode only. |
| S22 | 17 | Stores the ASCII decimal code for the XON character. |
| S23 | 19 | Stores the ASCII decimal code for the XOFF character. |
| S24 | 0 | Sets the duration, in 10-millisecond units, between pulsed DSR signals when the modem is set to &S1. S24 = 0 disables pulsed DSR. Maximum setting is 25 (250 msec.). |
| S26 | 1 | Sets the duration, in 10-millisecond units, of the delay between RTS and the modem's CTS response in synchronous mode. Default = 10 msec. |
| S27 | 0 | Selects Bell 103 or CCITT V.21 standard modulation at 300 bps. S27 = 0 selects Bell 103; S27 = 1 selects V.21, which enables overseas calls to U.S. installations.<br>Note that when S27 = 1, the modem answers both Bell 103 and CCITT V.21 calls, but only originates V.21 calls. |

| Register | Default | Function |
|---|---|---|
| S28 | 8 | Sets the duration of V.32 answer tones, in tenths of a second. This allows the Courier to connect in V.32 mode or to time out and fall back to try for a 2400-bps connection.<br><br>If you know the remote modem is calling at 2400 bps or below, setting this register to zero eliminates the tones and gives you a faster connect time. If you know that the remote modem begins handshaking at 2400 bps and then shifts to 9600 bps, lengthen the duration of the tones. However, if you set S28 to the allowed maximum, 255 (25.5 seconds), you disable all connections except 9600 bps in V.32 mode. |
| S38 | 0 | Sets the duration, in seconds, before a forced hang-up when DTR drops during an ARQ call. This is provided to allow time for a remote modem to acknowledge receipt of all transmitted data before the local modem hangs up and clears its Transmit buffer. Default = 0: the modem immediately hangs up when DTR drops. If the modem receives the ATH command, it ignores S38 and immediately hangs up. |

## APPENDIX B-6

## ASCII CHART

| ASCII CHART | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DEC | HEX | CHAR | DEC | HEX | CHAR | DEC | HEX | CHAR | DEC | HEX | CHAR |
| 00 | 00 | NUL | 32 | 20 | SP | 64 | 40 | @ | 96 | 60 | ` |
| 01 | 01 | SOH | 33 | 21 | ! | 65 | 41 | A | 97 | 61 | a |
| 02 | 02 | STX | 34 | 22 | " | 66 | 42 | B | 98 | 62 | b |
| 03 | 03 | ETX | 35 | 23 | # | 67 | 43 | C | 99 | 63 | c |
| 04 | 04 | EOT | 36 | 24 | $ | 68 | 44 | D | 100 | 64 | d |
| 05 | 05 | ENQ | 37 | 25 | % | 69 | 45 | E | 101 | 65 | e |
| 06 | 06 | ACK | 38 | 26 | & | 70 | 46 | F | 102 | 66 | f |
| 07 | 07 | BEL | 39 | 27 | ' | 71 | 47 | G | 103 | 67 | g |
| 08 | 08 | BS | 40 | 28 | ( | 72 | 48 | H | 104 | 68 | h |
| 09 | 09 | HT | 41 | 29 | ) | 73 | 49 | I | 105 | 69 | i |
| 10 | 0A | LF | 42 | 2A | * | 74 | 4A | J | 106 | 6A | j |
| 11 | 0B | VT | 43 | 2B | + | 75 | 4B | K | 107 | 6B | k |
| 12 | 0C | FF | 44 | 2C | , | 76 | 4C | L | 108 | 6C | l |
| 13 | 0D | CR | 45 | 2D | – | 77 | 4D | M | 109 | 6D | m |
| 14 | 0E | SO | 46 | 2E | . | 78 | 4E | N | 110 | 6E | n |
| 15 | 0F | SI | 47 | 2F | / | 79 | 4F | O | 111 | 6F | o |
| 16 | 10 | DLE | 48 | 30 | 0 | 80 | 50 | P | 112 | 70 | p |
| 17 | 11 | XON | 49 | 31 | 1 | 81 | 51 | Q | 113 | 71 | q |
| 18 | 12 | DC2 | 50 | 32 | 2 | 82 | 52 | R | 114 | 72 | r |
| 19 | 13 | XOFF | 51 | 33 | 3 | 83 | 53 | S | 115 | 73 | s |
| 20 | 14 | DC4 | 52 | 34 | 4 | 84 | 54 | T | 116 | 74 | t |
| 21 | 15 | NAK | 53 | 35 | 5 | 85 | 55 | U | 117 | 75 | u |
| 22 | 16 | SYN | 54 | 36 | 6 | 86 | 56 | V | 118 | 76 | v |
| 23 | 17 | ETB | 55 | 37 | 7 | 87 | 57 | W | 119 | 77 | w |
| 24 | 18 | CAN | 56 | 38 | 8 | 88 | 58 | X | 120 | 78 | x |
| 25 | 19 | EM | 57 | 39 | 9 | 89 | 59 | Y | 121 | 79 | y |
| 26 | 1A | SUB | 58 | 3A | : | 90 | 5A | Z | 122 | 7A | z |
| 27 | 1B | ESC | 59 | 3B | ; | 91 | 5B | [ | 123 | 7B | { |
| 28 | 1C | FS | 60 | 3C | < | 92 | 5C | \ | 124 | 7C | \| |
| 29 | 1D | GS | 61 | 3D | = | 93 | 5D | ] | 125 | 7D | } |
| 30 | 1E | RS | 62 | 3E | > | 94 | 5E | ^ | 126 | 7E | ~ |
| 31 | 1F | US | 63 | 3F | ? | 95 | 5F | _ | 127 | 7F | DEL |

Additional command summaries are on the bottom panel of the modem and in the Quick-Reference Card.

**Requirements**

1. Type commands in either upper or lower case.
2. All commands except A/, A> and + + + are preceded by the AT prefix and are executed with the Enter/ Carriage Return key (<Enter>).
3. Command length = 40 characters maximum. The modem doesn't count the AT prefix, Carriage Return character, or spaces. It counts but doesn't act on punctuation such as hyphens and parentheses.
4. A missing numeric parameter is assumed to be zero, as in the command to hang up: ATH <Enter> is the equivalent of ATH0 <Enter>.

## BASIC COMMAND SET

| Command/ Options | Function |
|---|---|
| & | See the Extended Command Summary that follows this Basic Set. |
| A | Force Answer mode when the modem hasn't received an incoming call. |
| A/ | Re-execute the last issued command one time. A/ doesn't take the AT prefix or a Carriage Return. |
| A> | Re-execute the last issued command continuously until canceled by pressing <any key>. Dial strings are re-executed ten times after which execution terminates. A> doesn't take the AT prefix or a Carriage Return. |
| <Any key> | Terminate current dialing operation resulting from an issued Dial command; terminate Repeat mode (> or A>). |
| AT | Attention: lets the modem know commands are being issued to it. *Must* precede all other commands except A/, A> and + + +. |

| | | |
|---|---|---|
| B*n* | | Handshake options |
| | B0 | V.32 operation; CCITT V.25 answer sequence. Default for Courier V.32. Required by Courier HST Dual Standard to answer V.32 calls. Also enables HST-mode modems to answer calls originating overseas. |
| | B1 | HST operation; Bell answer tone. Default for Courier HST Dual Standard and Courier HST; invalid for Courier V.32. |
| C*n* | | Transmitter enabled/disabled. |
| | C0 | Transmitter disabled; receive-only condition. |
| | C1 | Transmitter enabled (Default). |
| D | | Dial the number that follows and enter Originate mode. Optional parameters: |
| | P | Pulse dial (Default). |
| | T | Touch-Tone dial. |
| | , | (Comma) Pause for 2 seconds. |
| | ; | Return to Command mode after dialing. |
| | " | Dial the letters that follow. |
| | ! | Transfer call (flash switch-hook). |
| | W | Wait for second dial tone (with X3 or higher). |
| | @ | Wait for an answer (with X3 or higher). |
| | R | Reverse frequencies. |
| DS*n* | | Dial the phone number stored in NRAM at position *n* (*n* = 0–3). |
| E*n* | | Command mode local echo (display) of keyboard commands ON/OFF. DIP switch 4 is factory set to Command mode echo ON. |
| | E0 | Local echo OFF. |
| | E1 | Local echo ON. |

| | | |
|---|---|---|
| F*n* | | Online local echo of transmitted data ON/OFF. Sometimes referred to as the Duplex setting. |
| | F0 | Local echo ON. Sometimes called Half Duplex. Modem sends a copy to your screen of data it sends to the remote system. |
| | F1 | Local echo OFF (Default). Sometimes called Full Duplex. Receiving system may send a remote echo of data it receives. |
| H*n* | | On/off hook control. |
| | H0 | Hang up (go on hook). |
| | H1 | Go off hook. |
| I*n* | | Inquiry. |
| | I0 | Display product code. |
| | I1 | Display results of ROM checksum. |
| | I2 | Display results of RAM test. |
| | I3 | Display call duration or real time (see K*n*). |
| | I4 | Display current modem settings. |
| | I5 | Display NRAM settings. |
| | I6 | Display link diagnostics. |
| | I7 | Display product configuration. |
| K*n* | | Modem clock operation: Call-duration or Real-time mode. |
| | K0 | Return call duration at ATI3 (Default). |
| | K1 | Return actual time at ATI3. Clock is set using ATI3 = HH:MM:SS K1. |
| M*n* | | Monitor (speaker) control. |
| | M0 | Speaker always OFF. |
| | M1 | Speaker ON until carrier is established (Default). |
| | M2 | Speaker always ON. |
| | M3 | Speaker ON after last digit dialed and until carrier is established. |

| | | |
|---|---|---|
| O | | Return online after command execution. |
| P | | Pulse dial (Default). |
| Q*n* | | Quiet mode: result codes displayed/suppressed. DIP switch 3 is factory set to display result codes. |
| | Q0 | Result codes displayed. |
| | Q1 | Result codes suppressed (*quiet*). |
| S*r*=*n* | | S-register commands: *r* is any S-register; *n* must be a decimal number between 0 and 255. |
| S*r*? | | Query register *r*. |
| T | | Tone dial. |
| V*n* | | Return result codes in words or numbers (Verbal/Numeric mode). DIP switch 2 is factory set to verbal result codes. |
| | V0 | Numeric mode. |
| | V1 | Verbal mode. |
| X*n* | | Result code set options. Use the following table (Default = X1, Extended set, codes 0–5, 10). |

| RESULT CODES OPTIONS TABLE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Setting | | | | | | | |
| Result Codes | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X7 |
| 0/OK | ● | ● | ● | ● | ● | ● | ● | ● |
| 1/CONNECT | ● | ● | ● | ● | ● | ● | ● | ● |
| 2/RING | ● | ● | ● | ● | ● | ● | ● | ● |
| 3/NO CARRIER | ● | ● | ● | ● | ● | ● | ● | ● |
| 4/ERROR | ● | ● | ● | ● | ● | ● | ● | ● |
| 5/CONNECT 1200 | | ● | ● | ● | ● | ● | ● | ● |
| 6/NO DIAL TONE | | | ● | | ● | | ● | ● |
| 7/BUSY | | | | ● | ● | ● | ● | ● |
| 8/NO ANSWER | | | | ● | ● | ● | ● | ● |
| 9/RESERVED | | | | | | | | |
| 10/CONNECT 2400 | | ● | ● | ● | ● | ● | ● | ● |
| 11/RINGING | | | | | | ● | ● | ● |
| 12/VOICE | | | | | | ● | ● | |
| 13/CONNECT 9600 | | ● | ● | ● | ● | ● | ● | ● |
| 18/CONNECT 4800 | | ● | ● | ● | ● | ● | ● | ● |
| Functions | | | | | | | | |
| Adaptive Dialing | | | ● | ● | ● | ● | ● | ● |
| Wait for 2nd Dial Tone (W) | | | | ● | ● | ● | ● | ● |
| Wait for Answer (@) | | | | ● | ● | ● | ● | ● |
| Fast Dial | | | ● | | ● | | ● | ● |

NOTE: Depending on the &A setting, the following result codes are enabled/disabled. The default is &A1, /ARQ codes enabled.

14 CONNECT ARQ (only when modem is set to XØ)
15 CONNECT 1200/ARQ
16 CONNECT 2400/ARQ
17 CONNECT 9600/ARQ
19 CONNECT 4800/ARQ

Z Software reset to NRAM settings if DIP switch 10 is UP, to factory settings if DIP switch 10 is DOWN. Also initiates new settings of DIP switches 2–5 and 9.

| | |
|---|---|
| + + + | Escape code, preceded and followed by a guard time of at least one second of no data transmission. The modem responds to + + + by returning to Command mode and doing the following:<br><br>DIP switch 9 DOWN (ON, Factory setting):<br>Retains phone line connection<br>Sends OK result code<br><br>DIP switch 9 UP (OFF):<br>Hangs up<br>Sends NO CARRIER result code |
| > | Repeat the command continuously until canceled by pressing <any key>. If used in a Dial string, automated redialing terminates after ten attempts. |
| / | (Slash) Pause 125 milliseconds. |
| $ | Help command summary request. |
| &$ | Help extended command summary request. |
| D$ | Help Dial command summary request. |
| S$ | Help S-register summary request. |
| <Ctrl>-S | Stop/restart display of Help screens. |
| <Ctrl>-C or <Ctrl>-K | Cancel display of Help screens. |

## EXTENDED COMMAND SET

| Command/ Options | Function |
|---|---|
| &A*n* | Enable/disable /ARQ result codes. |
| &A0 | /ARQ result codes disabled. |
| &A1 | /ARQ result codes enabled (Default). |
| &B*n* | Data Rate, terminal-to-modem (DTE/DCE). |
| &B0 | DTE/DCE rate follows connection rate (Default). |
| &B1 | DTE/DCE rate fixed at the DTE setting. Allowable rates are 38.4K, 19.2K, 9600, 4800, 2400, 1200, 300 bps. |
| &B2 | Fixed DTE rate in ARQ mode; variable rate-switching in non-ARQ mode. |
| &F | Load factory (ROM) settings into random access memory (RAM). |
| &G*n* | Guard tone as part of answer sequence, for 2400/1200 bps calls from overseas. |
| &G0 | No guard tone, U.S., Canada (Default). |
| &G1 | 550 Hz guard tone, some European countries. |
| &G2 | 1800 Hz guard tone, U.K., some Commonwealth countries. Requires B0 setting. |
| &H*n* | Transmit Data flow control. |
| &H0 | Flow control disabled (Default). |
| &H1 | Hardware (CTS) flow control. |
| &H2 | Software (XON/XOFF) flow control. |
| &H3 | Hardware and software control. |

| | |
|---|---|
| &I*n* | Received Data software flow control. |
| &I0 | Flow control disabled (Default). |
| &I1 | XON/XOFF to local modem and remote computer. |
| &I2 | XON/XOFF to local modem only. |
| &I3 | Host mode, Hewlett Packard protocol. |
| &I4 | Terminal mode, Hewlett Packard protocol. |
| &I5 | XON/XOFF to remote modem for non-ARQ link flow control. |
| &J*n* | Phone Line Interface |
| &J0 | Single phone line—RJ11, RJ41S, or RJ45S phone jack (Default). |
| &J1 | Multiple phones/modems on line—RJ12 or RJ13 jack. |
| &K*n* | Data compression enabled/disabled. |
| &K0 | Disabled. |
| &K1 | Auto enable/disable (Default). Disabled if &B and &N rate settings are equal. |
| &K2 | Enabled regardless of &B and &N settings. |
| &L*n* | Leased line operation. |
| &L0 | Disabled (Default). |
| &L1 | Enabled. |
| &M*n* | Error Control (ARQ) and Synchronous Options. |
| &M0 | Normal asynchronous mode, error control disabled. |
| &M1 | Smart synchronous mode (asynchronous command mode except during synchronous connections). |
| &M2 | Reserved. |
| &M3 | Continuous synchronous mode. |

| | |
|---|---|
| &M4 | Normal/ARQ mode—Normal if ARQ connection cannot be made (Default). |
| &M5 | ARQ mode—hang up if ARQ connection cannot be made. |
| &N*n* | Link Rate (DCE/DCE) variable or fixed. With fixed link rate, modem hangs up if called or calling modem is operating at a different rate. |
| &N0 | Variable link operations; negotiate highest possible link rate with remote modem (Default). |
| &N1 | 300 bps. |
| &N2 | 1200 bps. |
| &N3 | 2400 bps. |
| &N4 | 4800 bps. |
| &N5 | 7200 bps. |
| &N6 | 9600 bps. |
| &N7 | 12K bps. |
| &N8 | 14.4K bps. |
| &P*n* | Pulse dialing make/break ratio. |
| &P0 | U.S./Canada make/break ratio (Default). |
| &P1 | U.K./some Commonwealth countries make/break ratio. |
| &R*n* | Received Data hardware (RTS) flow control. |
| &R0 | Delay before modem responds to DTE's RTS signal with CTS signal. Delay is set in S-register 26. |
| &R1 | Ignore RTS (Default). |
| &R2 | Received data sent to DTE only when RTS is high; used only if DTE supports RTS. |
| &S*n* | Data Set Ready (DSR) operations. |
| &S0 | DSR override, always ON (Default). |
| &S1 | Modem sends DSR to DTE to signal that it is ready for a call and drops DSR when it or the remote modem disconnects. |

| | |
|---|---|
| &W | Write current settings to nonvolatile random access memory (NRAM). |
| &X*n* | Synchronous Timing Source. This specifies which device generates the timing signals for the Transmit clock during a synchronous call. |
| &X0 | Modem's Transmit clock is the source (Default). |
| &X1 | DTE is the source. |
| &X2 | Modem's Receiver clock is the source; valid only in V.32 mode or for 2400/1200-bps connections in HST mode. |
| &Y*n* | Break handling. Destructive Breaks clear the buffer; expedited Breaks are sent immediately to the remote system. Under data compression, destructive Breaks reset the local and remote modem's compression tables. |
| &Y0 | Destructive, don't send Break. |
| &Y1 | Destructive, expedited (Default). |
| &Y2 | Nondestructive, expedited. |
| &Y3 | Nondestructive, unexpedited; modem sends Break in sequence with data received from terminal equipment. |
| &Z*n*=*s* | Write the following Dial string (*s*) to NRAM at position *n* (*n*=0–3). |
| &Z*n*? | Display the phone number stored in NRAM at position *n* (*n*=0–3). |

You may occasionally encounter one of the problems listed here. They are divided into two categories: before and during the exchange of user information over the data link.

| PROBLEM | SUGGESTED SOLUTION |
|---|---|
| **Before Establishment of the Data Link** | |
| *Your modem . . .* | |
| Doesn't answer the phone or go off hook to dial a number | Check to make sure your computer or terminal is sending a Data Terminal Ready (DTR) signal via the RS-232C interface. Check your software documentation for DTR requirements, and in this manual review Appendix B-1 and Appendix B-3, DIP switch 1. |
| Doesn't respond OK when you type AT <Enter> | 1. Make sure you're typing in either upper case or lower case letters, not a combination, and that you press the Enter key.<br>2. If you're using a computer, make sure it is in Terminal Mode. This is a communications software function. See *Testing the Modem* in Chapter 2.<br>3. Check to see that your terminal or software is set to the correct bit rate and word length (7 bits with or without a parity bit, or 8 bits and no parity). If you're using a computer, make sure your software is set to the correct communications port.<br>4. Check that DIP switch 8 is DOWN, for command set recognition. If the switch is UP, power off the modem, set the switch DOWN, and power on the modem again. Try typing AT <Enter> again.<br>If that doesn't work, check to see that the modem isn't in continuous synchronous mode (&M3) and can't respond to commands. Power off the modem, set DIP switch 10 DOWN, and power on the modem. This loads the modem's factory settings, including &M4. Try typing AT <Enter> again. |

| PROBLEM | SUGGESTED SOLUTION |
|---|---|
| Before Establishment of the Data Link | |
| | 5. Check that DIP switch 3 is DOWN, for result code display, and that DIP switch 2 is UP, for verbal result codes. If not, change the switch(es) and type ATZ <Enter>. Or type whichever of these commands is needed:<br>ATQ0 <Enter> (to enable the message)<br>ATV1 <Enter> (to display a verbal message) |
| | 6. Your system may require the Carrier Detect override (DIP switch 6 DOWN), but you've changed the factory setting. Check Appendix B-3 and your terminal or software documentation. |
| | 7. A rare condition is that your terminal or computer reverses the send/receive functions at the RS-232C interface. See Appendix B-1, Appendix B-3, Quad switch, and your equipment documentation. |
| *Your computer . . .* | |
| Reacts as though a data link has been established, but no call has been received | DIP switch 6 is set DOWN at the factory for Carrier Detect override, but your system may be reacting to improper signals received at the RS-232C interface. Set DIP switch 6 UP (OFF). |
| When the modem is in Answer mode, acts if a Carriage Return has been entered, but nothing has been typed at the keyboard | Your software may be misreading signals from the modem as it automatically sends a Carriage Return and a Line Feed before and after the RING and CONNECT messages. Sending the Quiet Mode command, ATQ1 <Enter>, should solve the problem. |

| PROBLEM | SUGGESTED SOLUTION |
|---|---|

Before Establishment of the Data Link

*Both modems . . .*

**Exchange carrier signals, but fail to establish a communications link**

1. Asynchronous operations: check to make sure the proper bit rate, word length, parity and number of Stop bits have been selected. Synchronous operations: review the instructions in Chapter 7. If you've set the modem to the correct configuration, the problem may be with the synchronous adapter or with the system you're trying to call.
2. Check to see that your modem is at the correct B*n* setting to connect with either an HST modem (B1 setting) or V.32 modem (B0 setting). Type ATI4 for a display of the Courier's current settings and, if necessary, send the modem the correct setting.
3. If your modem is attempting to answer a V.32 call, you may need to lengthen the V.32 answer tones. See S28 in Appendix B-5.
4. Make sure the modem at the other end of the line is USR-HST compatible at 14.4K or 9600 bps, V.32-compatible at 9600 bps, V.22*bis*-compatible at 2400 bps, Bell 212A-compatible at 1200 bps, or Bell 103-compatible at 300 bps. These are the common signaling standards for full duplex dial-up network transmission in the U.S.
5. If none of the above corrects the problem, it's likely that the quality of the phone connection is poor and that the other modem is missing the signals your modem is transmitting. The variable quality of phone line connections may be due to any number of conditions in the phone service's equipment or the current environment. Try several calls, and if you still can't get through, try calling another modem. If the second modem accepts your call, the problem may lie with the modem you first tried to call.

| PROBLEM | SUGGESTED SOLUTION |
|---|---|
| During Asynchronous Data Transfer | |
| *Your screen displays . . .* | |
| Only brackets | Check to make sure both modems are set at the same bit rate, word length, parity and number of Stop bits. If the settings are correct, the problem may be with the phone line. Try the following measures:<br>1. Try placing the call again. The phone company routes even local calls differently each time you call.<br>2. Try calling a different modem to see if the problem persists. |
| Random (garbage) characters | Make sure both modems are set at the same bit rate, word length, parity, and number of Stop bits. |
| Double characters | The modem's online local echo is on and the remote modem is also echoing. The only way to correct this is to bring the modem back to Command mode (wait one second without transmitting data, type + + +, wait another second). Then type the command to turn off your online echo (ATF1 <Enter>).<br>If DIP switch 9 is DOWN (factory setting) the modem maintains its connection. You can return it back online by typing ATO <Enter>. If DIP switch 10 is UP, the modem hangs up when it returns to Command mode, and you'll have to call again. |

## IF YOU STILL HAVE PROBLEMS

The problems described above are by far the most common ones that users encounter. If the suggestions we've given don't clear up your difficulties, try the following:

1. Review the manual carefully to see if you've missed something.
2. Call or visit your dealer. Chances are your dealer will be able to give you the assistance you need. This is much more efficient and time-saving than returning the modem to USRobotics.

3. If your dealer can't clear up your difficulties, call the USRobotics Technical Support Department at 800/982-5151 (in Illinois, 312/982-5151). Our Service Representatives will be happy to give you assistance over the phone Monday through Friday from 8:30 a.m. to 5 p.m. (Central Time Zone).

4. If necessary, the Service Representative you talk to may give you a Return Materials Authorization (RMA) number. *Modems without an RMA number will not be accepted.*

5. If you do return the modem to us, please follow this procedure—

   a. Ship the unit, postage paid, in its original container. If the original container is not available, pack the modem carefully in a strong box of corrugated cardboard with plenty of packing material.

   b. Be sure to include your RMA number inside the package, along with your name and address. *Put your return address and your RMA number on the shipping label as well.*

   c. Ship the well-packed modem to the following address.

      Technical Support Department
      U.S. Robotics, Inc.
      8100 North McCormick Boulevard
      Skokie, Illinois 60076

   d. Please note that USRobotics will not accept packages sent COD, so be sure to send the modem postage paid.

   e. USRobotics will repair your modem and return it to you via United Parcel Service.

# ADDITIONAL OPERATIONAL INFORMATION

CONTENTS

E-1 Using Both Voice and Data Communications

E-2 High Speed/Low Speed Protocol

E-3 Link Negotiation (Handshaking) and Retraining

E-4 PBX, Dedicated Line, and Leased Line Operations

E-5 Hewlett Packard 3000 Installations

## APPENDIX E-1

## USING BOTH VOICE AND DATA COMMUNICATIONS

When you assemble the Courier, you have the option of plugging your phone into the second modular jack of the modem so it's available for voice calls. You can also use the phone to set up asynchronous communications with another user whose modem uses the AT command set, such as a USRobotics or USRobotics-compatible modem.

### PREPARATION

First call the other user to establish the bit rate, parity, word length and number of Stop bits the other person's modem accepts. Then both of you can turn the call over to your modems.

### COMMANDS

1. Without hanging up the phone, have your modem go off hook in Originate mode. Type the following command:

   ATD <Enter>

   NOTE: Be sure the modem is *not* set to X2, X4, X6, or X7, or it will return the NO DIAL TONE result code and hang up.

2. The other party should then have the remote modem go off hook in Answer mode. The following command is used to do this:

   ATA <Enter>

3. Now both of you can hang up your respective phones while the two modems establish the data link. They will maintain the link until one of you gives your modem a command to disconnect.

   Either party's device can be the originate or answer modem: it doesn't matter who made the phone call. But one modem must first enter Originate mode and the other then enter Answer mode. You and the other party, therefore, must agree on which command, ATD or ATA, you will each use.

   NOTE: It may happen that spurious *garbage* characters will appear on the screen when you hang up the phone. You can avoid these by hanging up the phone as soon as you hear the modem go off hook, during the one or two seconds it takes the two modems to establish the link.

## OVERVIEW

This appendix is intended for those users who want to try programming their computers to switch bit rates to match the Courier's connection rate. The material here applies only to asynchronous calls, when the modem is set for variable rates at both the DTE (computer) and link interfaces, &B0 and &N0, respectively.

In both Originate or Answer modes, if the link rate is set to &N0 the Courier negotiates with the remote modem to connect at the highest possible rate. In addition, if the modem is set to the Extended or Advanced result codes (X1 or higher) it signals the DTE with one of the following result codes or, unless the call is at 300 bps, an /ARQ mode equivalent:

| | |
|---|---|
| CONNECT | (300 bps) |
| CONNECT 1200 | (1200 bps) |
| CONNECT 2400 | (2400 bps) |
| CONNECT 4800 | (4800 bps) |
| CONNECT 9600 | (9600 bps) |

The modem sends the result code at its previous rate. Then it switches to the new connection rate.

If your computer doesn't switch rates and you want to program it to do so, use the example on the next page as a guide. It demonstrates the occurrence of the CONNECT codes in the connection sequence, so that recognition of the codes can be used to switch the computer. The example uses a sequence of incoming calls, but the codes apply to Originate mode connections as well.

The example assumes the following settings:

| | |
|---|---|
| Software: | Initially 9600 or 19.2K, or 38.4K bps, allowing the following range of link rates: 9600/4800/2400/1200/300/110 bps |
| Modem: | X1 or higher (rate-specific CONNECT codes)<br>&B0 (variable DTE rate)<br>&N0 (variable link rate) |

NOTE: The Courier HST link rate of 14.4K bps is not included because the modem must be set to &B1 and the DTE rate fixed at either 19.2K or 38.4K. The rate-switching discussed here is limited to a maximum of 9600 bps.

Example

| Action | Modem Response | DTE/DCE Rate |
|---|---|---|
| 1. Power on. | | 9600 |
| 2. 300-bps call comes in. | RING<br>CONNECT | 9600<br>9600 |
| 3. Data link is established. Data transfer takes place. | | 300 |
| 4. Data session is over. Call is ended; loss of carrier. | NO CARRIER | 300 |
| 5. 2400-bps call comes in. | RING<br>CONNECT 2400 | 300<br>300 |
| 6. Data link is established. Data transfer takes place. | | 2400 |
| 7. Data session is over. Call is ended; loss of carrier. | NO CARRIER | 2400 |
| 8. 9600-bps call comes in. | RING<br>CONNECT 9600 | 2400<br>2400 |
| 9. Data link is established. Data transfer takes place. | | 9600 |
| 10. Data session is over. Call is ended; loss of carrier. | NO CARRIER | 9600 |

Explanation

1. The modem is powered on and is operating at 9600 bps. If the software is then set to 19.2K bps and an AT command sent, the DTE/DCE rate would be 19.2K bps.

2. A 300-bps modem calls. The Courier senses the incoming signal and sends the messages RING and CONNECT to the computer. These messages are sent at 9600 (or 19.2K) bps, the current rate.

3. Since the Courier responds CONNECT, rather than CONNECT 1200, 2400, or 9600, the computer switches to 300 bps. The modem automatically shifts to 300 bps to accept the data from the incoming call.

4. The 300-bps data session is terminated; the modem sends the computer the message NO CARRIER at 300 bps.
5. A 2400-bps call comes in. The modem responds RING and CONNECT 2400. These message are sent at the current bit rate of 300 bps.
6. The computer, receiving the CONNECT 2400 message, adjusts accordingly to the higher bit rate. The modem also shifts to 2400 bps.
7. The 2400-bps data session is terminated; the modem sends the computer the message NO CARRIER at 2400 bps.
8. A 9600-bps call comes in. The modem responds RING and CONNECT 9600. These messages are sent to the computer at the current bit rate of 2400 bps.
9. The computer, receiving the CONNECT 9600 message, adjusts accordingly to the higher bit rate. The modem also shifts to 9600 bps.
10. The 9600-bps data session is terminated; the modem sends the message NO CARRIER at 9600 bps.

NOTE: If online fallback occurs during a 9600-bps call, the modem does not send CONNECT result codes for 7200- or 4800-bps link rates.

Keep in mind that whether or not your computer adjusts to these rate changes, the Courier automatically shifts connection rates if it is set to &NØ.

## APPENDIX E-3

## LINK NEGOTIATION (HANDSHAKING) AND RETRAINING

### LINK NEGOTIATION

When the Courier modem is set for high-speed operations, timing and procedures differ during link negotiation, as follows.

### *HST Mode, Error Control*

Your DTE rate: 38.4K/19.2K/9600 bps
Courier settings: B1, &H1/&H2/&H3, &M4/&M5, &N0

*Operation:* The modems begin handshaking at 2400 bps. The lower initial rate maintains compatibility with the existing telephone network as well as existing hardware and software. The modems train (synchronize) at 2400 bps and exchange link requests. These requests identify each one's error control levels and speed capabilities.

If the remote modem is operating at 2400 bps or lower, the Courier stays at 2400 bps or falls back to match the remote modem's rate. If the remote modem is HST-compatible and operating at a higher speed, both modems shift up and train at 9600 bps. From there, if possible, they shift up again to 12K bps and again to 14.4K bps. Or, if necessary, they fall back to 7200 bps and again to 4800 bps, if the remote modem is operating at one of those lower speeds.

NOTE: If you have a Courier HST Dual Standard modem and use it mainly for HST-mode calls, your connect time will be shorter if you disable V.32 mode. Set S28 to zero and reset it to its default only for V.32 calls. See S28 in Appendix B-5.

### *Optional High-Speed Connect*

It's possible for two modems in HST mode to connect directly at 14.4K or 9600 bps, without 2400-bps handshaking, but *both modems* must be set as follows:

Your DTE rate: 38.4K/19.2K/9600 bps
Courier settings: B1, &H1/&H2/&H3, &M4/&M5, &N6/&N8

### *HST Mode, No Error Control*

We do not recommend operating the Courier at high speeds without error control. The only instance where such operation may be required is where mainframe software provides error control.

DTE rate: 38.4K/19.2K/9600 bps
Courier settings: B1, &H1/&H2/&H3, &M0, &N0 or higher

*Operation:* When the HST/MNP protocol is disabled, handshaking proceeds in one of two ways:

1. If the Courier is set to &N0, for variable link rates, the connection sequence starts at 2400 bps as described earlier. The modems stay at that rate or the Courier falls back to match a lower rate of the remote modem. It does not attempt a link rate higher than 2400 bps.

2. If the Courier's link rate is fixed at a rate higher than 2400 bps (&N4 through &N8) the modem initiates handshaking at the specified rate. If the remote modem is not operating at the specified rate, the Courier hangs up.

   NOTE: Without error control, there are no high speed line reversals. The high speed channel is always allocated to the answering modem. Also, there is no online fall-back to protect your connection.

### *V.32 Mode*

Your DTE rate: 38.4K/19.2K/9600 bps
Courier settings: B0, &H1/&H2/&H3, &M4/&M5, &N0

*Operation:* The Courier begins handshaking at 9600 bps. If the remote modem is V.32 compatible but operating at 4800 bps, the Courier falls back to connect at 4800 bps. If the remote modem is operating at 2400, 1200, 300 or 110 bps, the Courier falls back to match the lower rate.

If the Courier is set to &N4 (4800 bps) or &N6 (9600 bps), it only connects at the specified rate. If the remote modem is operating at a different rate, the Courier hangs up.

NOTE: Not all V.32 modems that are also compatible at 2400 bps and below handshake in the same way as Courier V.32 modems. Some V.32 modems begin handshaking at 2400 bps (V.22 modulation) and then shift up to 9600 bps. A Courier in V.32 mode, as mentioned above, begins at 9600 bps with V.32 signals. If you have a problem connecting with another V.32 modem, it may be that the remote V.32 modem does not shift up to 9600 bps quickly enough. Try lengthening the duration of the Courier's V.32 tones by setting S-register 28 higher than its 0.8-second default.

### *Dual Standard Handshaking*

USRobotics Dual Standard modems automatically connect with each other regardless of their mode, HST or V.32, as long as they are also set to variable link rates, &N0, and to error control, &M4 or &M5.

If both Dual Standard modems have the same handshake setting, BØ or B1, they connect in the specified mode. If one is set to BØ and the other is set to B1, the BØ modem disables V.32 mode and switches to HST handshaking. This handshaking begins at 2400 bps and proceeds to the highest possible link speed, from 14.4K bps down to 110 bps.

Transmitter and Receiver frequencies for all speeds are listed in Appendix H, *Technical Specifications.* In addition, you may wish to keep the following in mind.

### *B1 Setting*

*Originate mode.* The modem sends out a 375 Hz tone. This tone is ignored by all V.32 modems except a Courier Dual Standard in V.32 mode. The answering Dual Standard responds to the tone by disabling V.32 signaling and switching to HST modulation.

*Answer mode.* V.32 answer tones are disabled. The only V.32 modem the Courier connects with is a Dual Standard modem which, when it does not detect V.32 answer tones, switches to HST modulation.

### *BØ Setting*

*Originate mode.* On detection of the V.32 answer tone sequence, both modems connect in V.32 mode. If the Courier Dual Standard does not detect the V.32 sequence, it switches to HST modulation.

*Answer mode.* The modem ordinarily sends the V.32 answer sequence, a 2100 Hz tone followed by 3000 and 600 Hz tones. But if a calling Dual Standard sends the 375-Hz HST tone, the answering modem responds by disabling V.32 mode and switching to HST modulation.

## RETRAINING

The retrain sequence occurs at 2400 bps and higher. It is a resynchronization sequence performed when one of the connected modems senses that problems on the line may affect data reliability. The procedure is essentially transparent to users.

The following is an example of retrain events:

1. The Courier's receiver, sensing a need to retrain, clamps received data to MARKs (a series of binary 1's).
2. The remote modem, after receiving about 100 milliseconds of analog signals (a pattern of ?˜?˜ is usually output), clamps received data to MARKs.

3. After the training sequence, approximately one second, the Courier unclamps received data and, if the call is over 2400 bps, turns the HS indicator on.
4. The remote modem re-enters Data mode.

# APPENDIX E-4

## PBX, DEDICATED LINE, AND LEASED LINE OPERATIONS

The following operations apply in installations where the modem is not directly connected to the public-access switched telephone network.

### Key System PBX Installations (RJ12/RJ13 Jacks)

RJ12 and RJ13 phone jacks have two leads (A and A1) in addition to those on the common RJ11 jack. When the connected phone or modem goes off hook, the A/A1 leads are shorted, causing the PBX off-hook indicator for that extension to light, indicating that the line is busy. If you're using either an RJ12 or RJ13 jack, set the modem to &J1 so that the off-hook indicator lights when the modem goes off hook:

AT&J1 <Enter>

### *Calling an Outside Party*

To have the modem make an outside call, follow the autodial instructions in Chapter 6, but insert the sequence used to obtain an outside line, followed by a W, before the phone number in the Dial command.

The off-hook indicator on the PBX should show the extension as busy if the modem is set to &J1.

### *Internal Calling*

To call another modem on the PBX system, use the Dial command described in Chapter 6 with the number of the extension you wish to call. If set to Auto Answer, the called modem automatically answers on the incoming ring.

The off-hook indicators on the PBX should show both extensions as busy if both modems are set to &J1.

### User-Installed or Leased Line Telephone Line

These lines are often referred to as dedicated or private lines. User-installed lines are most commonly 2-wire lines, similar to the 2-wire lines that connect residential phones to the public switched network. Lines leased from the telephone company are 4-wire lines, often designated as 3002 Analog Circuits. In some installations the telephone company also installs 4-wire to 2-wire converters at each end of the connection. For optimal operations, we recommend that the physical length of these lines not exceed 5 miles.

In both types of installation there is a continuous point-to-point connection between two modems. No dialing of phone numbers is required.

To establish the connection, follow these steps:

1. Write the &L1 setting to NRAM:

   AT&L &W <Enter>

   This enables the modems to re-establish the connection should it be broken.

2. Decide which modem is to be the Originate modem and which the Answer modem. The originate and answer frequencies must be defined for the modems to communicate.

3. First put the calling modem in Originate mode with the manual Dial command:

   ATD <Enter>

   NOTE: Be sure the modem is *not* set to X2, X4, X6, or X7, or it will return the NO DIAL TONE result code and hang up.

3. Then put the answering modem in Answer mode with the manual Answer command:

   ATA <Enter>

NOTE: If there is an interruption in the communications link (a strike to the line due to weather or some other problem), the modems will automatically restore the connection as long as they are set to &L1.

During error control connections, the Courier recognizes the ASCII ENQ/ACK characters exchanged between the Hewlett Packard 3000 host computer and its terminals. The HP host sends the terminal an ENQ character at predefined intervals, and sends no more data until the terminal responds with an ACK character.

Courier modems manage this ENQ/ACK protocol so that communication is speeded up, thereby enabling HP terminals to achieve high speeds on dial-up lines. Special Received Data flow control settings (the &I command) are used. These settings do not affect connections with modems that do not observe HST/MNP error control.

Follow these guidelines:

1. Use one of the &I settings given here for both Normal and error control (ARQ) sessions, and for both HST and V.32 modes, B0 or B1.
2. Do not use a software setting for Transmit Data flow control. Set the modem only to &H0 or &H1, according to the guidelines in Chapter 4.
3. Set the Courier to Host mode if it is attached to the host computer, or to Terminal mode if it is attached to a terminal, as follows:

   Host mode AT&I3 <Enter>

   Terminal mode AT&I4 <Enter>

CONTENTS

F-1 Digital Loopback
F-2 Analog Loopback Self-Test
F-3 Remote Digital Loopback
F-4 Additional Tests

# DIGITAL LOOPBACK

## OVERVIEW

This test checks the modem's RS-232C interface and the cable connecting the computer to the modem. During Digital Loopback, the modem receives digital data from the computer and immediately echoes it to the screen. As shown in Figure F.1, the data does not go to the modem's transmitter to be modulated into analog form.

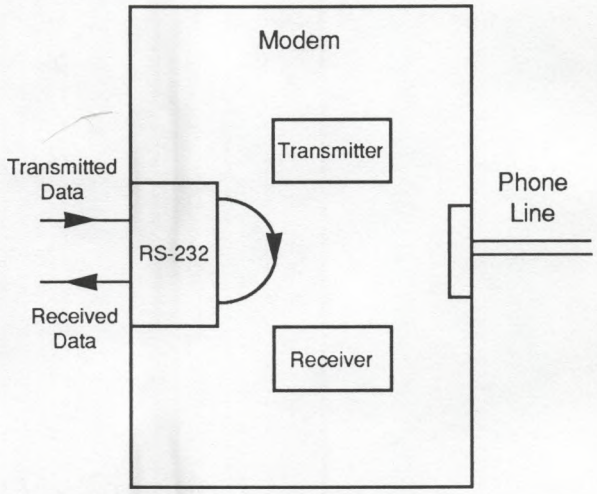


**Figure F.1—Data Flow, Digital Loopback**

## PROCEDURES

Follow these procedures to test the RS-232C interface using your own data entered at the keyboard.

1. If necessary, load your communications software and put your computer in Terminal mode. This causes the computer to function as a terminal, i.e., everything you enter at the keyboard goes directly to the modem.
2. If your modem is in Answer mode, you'll want to perform the test without the chance of being interrupted by an incoming call. Disable Answer mode with this command:

   ATS0=0 <Enter>

3. To guarantee that everything you enter will be echoed back to your screen, you need the modem's local echo ON. If the echo is not ON, type:

   ATE1 <Enter>

   To avoid double characters, be sure your software's local echo is OFF.

4. Now you can start the test by typing a message. If the RS-232C interface is okay, the message is echoed back to your screen.

   If errors appear, the problem may be your RS-232C cable. Replace it and then repeat the test. If errors still appear, make sure that the Quad Dip switch is UP. (See Appendix B-3.) This switch may have been accidentally changed.

# ANALOG LOOPBACK SELF-TEST

## OVERVIEW

This test is a way to check that the modem's transmitter and receiver are working properly. During Analog Loopback, data from the computer is sent in a loop through the transmitter (where it is modulated into analog form) and the receiver (where it is demodulated into digital form), and returned to the screen. The data path is shown in Figure F.2.

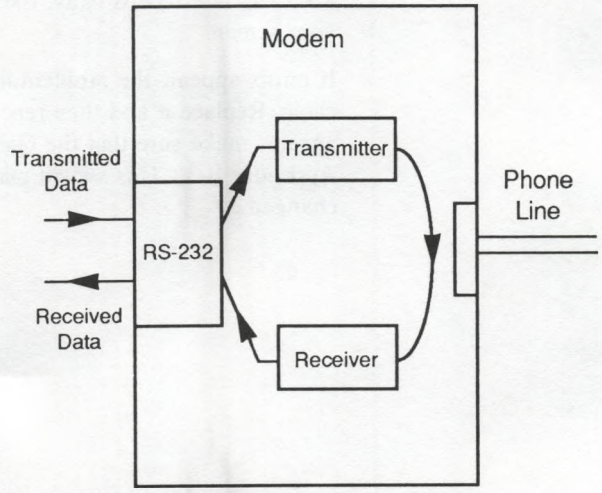


**Figure F.2—Data Flow, Analog Loopback**

## PROCEDURES

You can use the modem's internal test pattern as data, or enter your own at the keyboard. The following procedures test the modem by sending the test pattern.

NOTE: If the modem is set to X2, X4 X6, or X7 it will return the NO DIAL TONE result code and hang up. If necessary, send the modem a different X setting.

1. If the Courier is in HST mode, set your terminal or software to 2400 bps. Or set the modem to &B1 (fixed DTE rate) and set your terminal or software to 9600 bps. Otherwise, you will not get valid results due to asymmetrical modulation.

   If the Courier is in V.32 mode, set your terminal or software to 9600 bps.

Send the modem the following command, which has the results listed below.

AT &MØ S16=5D <Enter>

| | |
|---|---|
| &MØ | Sets the modem to Normal mode. If the modem is set for error control (&M4 or &M5) you can't tell if there is a problem because the modem checks for errors and automatically retransmits any errored data. |
| S16=5 | Sets S-Register 16 to Analog Loopback with test pattern. The modem sends, modulates and demodulates its internal test pattern and returns that pattern to your screen. |
| D | The Dial command selects testing the Originate (Dial) frequency. The Answer command (A) tests the Answer frequency. |

The modem enters Analog Loopback mode, goes off hook, sends a CONNECT message to the screen, and then sends the test pattern.

2. When you're satisfied with the test, terminate the operation by pressing any character key on the keyboard. The modem goes back on hook and responds with the message NO CARRIER.
3. Reset the error control default and reset S-Register 16 to zero, for data operations, with this command:

AT &M4 S16=Ø <Enter>

### Normal/Test Frequencies

In normal operations, communicating modems transmit at different frequencies within the communications channel, one low and the other high. The calling modem is said to be in Originate mode: it transmits at the low (Originate) frequency and receives at the high frequency. The answering modem, in Answer mode, transmits at the high (Answer) frequency, and receives on the low frequency.

During Analog Loopback testing, the modem transmits and receives on the same frequency, either Originate (low) or Answer (high). The Analog Loopback command in the previous section tests the Originate frequency.

### Testing the Answer Frequency

To test the Answer frequency, substitute the Answer command, A, as follows:

AT &MØ S16=5A

### Testing without the Test Pattern

1. Select this option to perform analog loopback testing by sending your own data instead of the test pattern. Use either of the following commands after setting your terminal or software as in Step 1 in the previous section. If the modem is set for error control, insert &MØ before the S16 command.

   ATS16=1D <Enter>
   ATS16=1A <Enter>

2. When the modem displays the message CONNECT 2400, enter any message you wish at the keyboard. It is looped through the modem and returned to the screen.

3. End the test by not entering anything for at least one second and then entering the escape code that brings the modem back to Command mode. (Do not enter the AT prefix or press the Enter key.)

   +++

4. The modem returns the OK message. Send the modem the following command to reset the error control default, reset S-Register 16 to zero, for data operations, and instruct the modem to hang up.

   AT &M4 S16=Ø H <Enter>

### Testing at 1200/300 BPS

To test the modem at 1200 or 300 bps, follow the previous instructions, but first set your terminal or software to 1200 or 300 bps.

NOTE: It might happen that you have issued either S16=1 or 5 and the modem is in Analog Loopback mode, but you haven't yet sent a Dial or Answer command to initiate testing. If the modem is also set for Auto Answer and a call comes in, the Courier resets S16 to zero and answers the call.

## OVERVIEW

This test checks operation on the phone link and the remote modem's transmitter and receiver. To perform this test, you need to be connected with another modem that supports Remote Digital Loopback (RDL) testing. The data path is shown in Figure F.3.

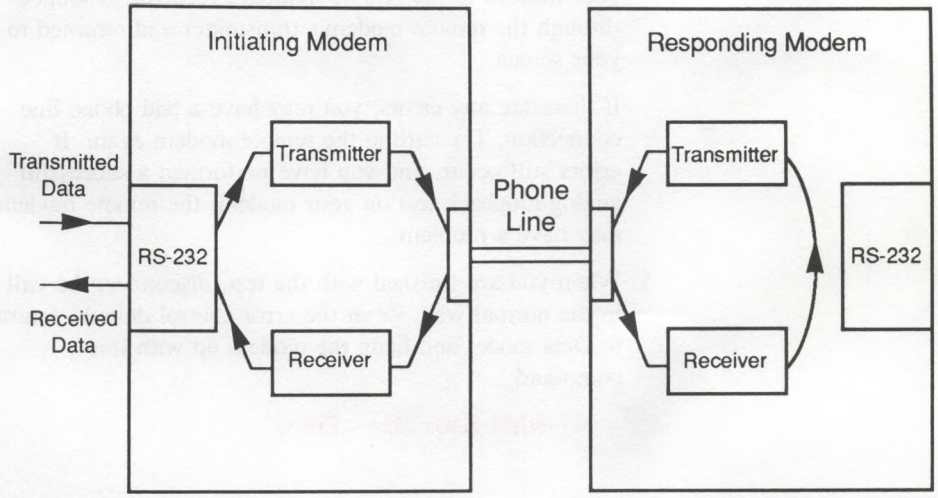


**Figure F.3—Data Flow, Remote Digital Loopback**

## PROCEDURES

In HST mode, this test must be performed at speeds of 2400 or 1200 bps; in V.32 mode, use 9600 bps.

1. Make sure that the remote modem's operator is expecting your call. Once the modems are in Test mode, the remote modem's transmitter and receiver will be engaged in testing and unavailable to the remote user.

2. Call the remote modem with the following command:

   AT &MØ D *phone number*; <Enter>

   The command also disables error control (&MØ) so that you can detect invalid data. The semicolon forces the modem back to command mode so that you can perform the test.

3. Initiate Remote Digital Loopback (RDL) with the following command:

   AT S16=8 O <Enter>

   The modem goes back online (O command) and sends the remote modem CCITT-defined RDL signals.

4. Type a message at the keyboard. The message goes from your modem to the remote modem's receiver, is looped through the remote modem's transmitter and returned to your screen.

   If there are any errors, you may have a bad phone line connection. Try calling the remote modem again. If errors still occur, and you have performed a successful analog loopback test on your modem, the remote modem may have a problem.

5. When you are finished with the test, disconnect the call in the normal way. Reset the error control default, return to Data mode, and hang the modem up with this command:

   AT &M4 S16=0 H <Enter>

## ADDITIONAL TESTS

In all, S-register 16 has six settings, as follows.

- 0 Data mode (normal operations)
- 1 Analog Loopback
- 2 Dial Test
- 4 Test Pattern
- 5 Analog Loopback with Test Pattern
- 8 Remote Digital Loopback

NOTE: After any testing, be sure to reset S-register 16 for Data mode, with or without the default error control setting (&M4):

AT &M4 S16=0 <Enter>

**S16=2** The Dial Test is used for factory testing the frequencies of Touch-Tone values. When S-register 16 is set to 2 and a single Touch-Tone is dialed (e.g., ATD7 <Enter>), the modem continues to transmit that tone until you type another Carriage Return.

**S16=4** The Test Pattern alone is used for testing equipment and the phone line. If S16 is set to 4 and a Dial command issued, the Courier transmits the test pattern upon connection to the remote system. If set for Auto Answer the Courier transmits the test pattern when it answers a call. Be sure to reset S16 to zero for normal calls.

Cross-references in the following definitions are printed in boldface.

**Analog Loopback** — A modem self-test in which data from the keyboard is sent to the modem's transmitter, modulated into **analog** form, looped back to the receiver, demodulated into **digital** form, and returned to the screen for verification. Tests either the modem's originate or answer frequency.

**Analog signals** — Continuous, varying waveforms such as the voice tones carried over phone lines. Contrast with **digital signals**.

**Answer Mode** — A state in which the modem transmits at the predefined high frequency of the communications channel and receives at the low frequency. The transmit/receive frequencies are the reverse of the calling modem which is in **Originate mode**.

**ARQ** — Automatic Repeat Request. A general term for error control protocols which feature error detection and automatic retransmission of defective blocks of data. See **HST** and **MNP**.

**ASCII** — American Standard Code for Information Interchange. A 7-bit binary code (Ø's, 1's) used to represent letters, numbers, and special characters such as $, !, and /. Supported by almost every computer and terminal manufacturer. See Appendix B-6 for decimal and hexadecimal code equivalents.

**Asynchronous Transmission** — Data transmission in which the length of time between transmitted characters may vary. Because the time lapses between transmitted characters are not uniform, the receiving modem must be signaled as to when the data bits of a character begin and when they end. The addition of Start and Stop bits to each character serves this purpose. Compare **Synchronous Transmission**.

**Auto Answer** — A feature in modems enabling them to answer incoming calls over the phone lines without the use of a telephone receiver.

**Auto Dial** — A feature in modems enabling them to dial phone numbers over the phone system without the use of a telephone transmitter.

**Baud Rate** — The number of discrete signal events per second occurring on a communications channel. Although not technically accurate, baud rate is commonly used to mean **bit rate**.

**Bisync** — Binary Synchronous Control. An earlier protocol developed by IBM for software applications and communicating devices operating in synchronous environments. The protocol defines operations at the link level of communications, for example, the format of data **frames** exchanged between modems over a phone line. See **Protocol, HDLC, SDLC**.

**Binary Digit** — A 0 or 1, reflecting the use of a binary numbering system (only two digits). Used because the computer recognizes either of two states, OFF or ON. Shortened form of binary digit is *bit*.

**Bit Rate** — The number of **binary digits** or bits transmitted per second (**bps**). Communications channels using telephone channel modems are established at set bit rates, commonly 110, 300, 1200, 2400, 4800, 9600, and 14400.

**BPS** — The bits (**binary digits**) per second rate.

**Buffer** — A memory area used as temporary storage during input/output operations. An example in the Courier is the command buffer that stores the last issued command. Another is the Transmit Data flow control buffer used for flow control and to store copies of transmitted **frames** until they are positively acknowledged by the receiving modem.

**Byte** — A group of **binary digits** stored and operated upon as a unit. A byte may have a coded value equal to a character in the ASCII code (letters, numbers), or have some other value meaningful to the computer. In user documentation, the term usually refers to 8-bit units or characters. 1 kilobyte (K) is equal to 1,024 bytes or characters; 64K indicates 65,536 bytes or characters.

**Carrier** — A continuous frequency capable of being either modulated or impressed with another information-carrying signal. Carriers are generated and maintained by modems via the transmission lines of the telephone companies.

**CCITT** — An international organization that defines standards for telegraphic and telephone equipment. For example, the Bell 212A standard for 1200 bps communication in North America is observed internationally as CCITT V.22. For 2400 bps

communication, most U.S. manufacturers observe V.22*bis*. The initials CCITT represent the French name; in English it's known as the International Telegraph and Telephone Consultative Committee.

**Character** — A representation, coded in **binary digits**, of a letter, number, or other symbol.

**Characters Per Second** — A data transfer rate generally estimated from the bit rate and the character length. For example, at 2400 bps, 8-bit characters with Start and Stop bits (for a total of ten bits per character) will be transmitted at a rate of approximately 240 characters per second (cps). Some protocols, such as USR-**HST** and **MNP**, employ advanced techniques such as longer transmission **frames** and data compression to increase cps.

**Cyclic Redundancy Checking (CRC)** — An error-detection technique consisting of a cyclic algorithm performed on each block or **frame** of data by both sending and receiving modems. The sending modem inserts the results of its computation in each data block in the form of a CRC code. The receiving modem compares its results with the received CRC code and responds with either a positive or negative acknowledgment. In the ARQ protocol implemented in Courier modems, the receiving modem accepts no more data until a defective block is received correctly.

**Data Communications** — A type of communications in which computers and terminals are able to exchange data over an electronic medium.

**Data Compression Table** — A table of values assigned for each character during a call under data compression. Default values in the table are continually altered and built during each call: the longer the table, the more efficient throughput gained.

If a destructive Break is sent during a call (see the &Y command), causing the modems to reset the compression tables, you can expect diminished throughput.

**DCE** — Data Communication (or Circuit-Terminating) Equipment. In this manual, the term applies to dial-up modems that establish and control the data link via the telephone network.

**Dedicated Line** — A user-installed telephone line used to connect a specified number of computers or terminals within a limited area, for example, one building. The line is a cable rather than a public-access telephone line. The communications channel may also be referred to as nonswitched because calls do not go through telephone company switching equipment.

**Default** — Any setting assumed, at startup or reset, by the computer's software and attached devices, and operational until changed by the user.

**Digital Loopback** — A test that checks the modem's RS-232C interface and the cable that connects the terminal or computer and the modem. The modem receives data (in the form of **digital signals**) from the computer or terminal, and immediately returns the data to the screen for verification.

**Digital Signals** — Discrete, uniform signals. In this manual, the term refers to the **binary digits** 0 and 1.

**DTE** — Data Terminal (or Terminating) Equipment. The device, such as a personal computer, terminal, or mainframe that generates or is the final destination of data.

**Duplex** — Indicates a communications channel capable of carrying signals in both directions. See **Half Duplex**, **Full Duplex**.

**EIA** — Electronic Industries Association, which defines electronic standards in the U.S.

**Equalization** — A compensation circuit designed into modems to counteract certain distortions introduced by the telephone channel. Two types are used: fixed (compromise) equalizers and those that adapt to channel conditions. Courier modems use adaptive equalization.

**Error Control** — Various techniques which check the reliability of characters (**Parity**) or blocks of data. The Courier's error control protocol provides error control through error detection (**CRC**) and retransmission of errored frames (**ARQ**).

**Flow Control** — A mechanism that compensates for differences in the flow of data input to and output from a modem or other device.

**Frame** — A data communications term for a block of data with header and trailer information attached. The added information usually includes a frame number, block size data, error-check codes, and Start/End indicators.

**Full Duplex** Signal flow in both directions at the same time. In microcomputer communications, may refer to the suppression of the online **Local Echo**.

**Half Duplex** Signal flow in both directions, but only one way at a time. In microcomputer communications, may refer to activation of the online **Local Echo**, which causes the modem to send a copy of the transmitted data to the screen of the sending computer.

**HDLC** High Level Data Link Control. A standard protocol developed by the International Standards Organization for software applications and communicating devices operating in synchronous environments. The protocol defines operations at the link level of communications, for example, the format of data **frames** exchanged between modems over a phone line. See **Bisync, Protocol, SDLC**.

**HST** High Speed Technology, part of the trademark for USRobotics' USR-HST modems. A proprietary signaling scheme, design and protocol for high-speed modems. USR-HST incorporates trellis-coded modulation, for greater immunity from variable phone line conditions, and asymmetrical modulation for more efficient use of the phone channel at speeds of 4800 bps and above. Asymmetrical modulation is less costly than the echo canceling required by **V.32** modulation. HST also incorporates **MNP**-compatible error control procedures adapted to asymmetrical modulation.

**Hz** Hertz, a frequency measurement unit used internationally to indicate one cycle per second.

**Local Echo** A modem feature that enables the modem to send copies of keyboard commands and transmitted data to the screen. When the modem is in Command mode (not online to another system) the local echo is invoked through the ATE1 command. The command causes the modem to display your typed commands. When the modem is online to another system, the local echo is invoked through the ATF0 command. This command causes the modem to display the data it transmits to the remote system.

**MNP** Microcom Networking Protocol. An asynchronous error control protocol developed by Microcom, Inc. and now in the public domain. The protocol ensures error-free transmis-

sion through error detection (**CRC**) and retransmission of errored frames. Courier modems use MNP Service Levels 1–5, although in HST mode Levels 1–4 have been modified to accommodate asymmetrical modulation. Compare **HST**.

**Modem**

A device that transmits/receives computer data through a communications channel such as radio or telephone lines. The Courier is a telephone channel modem that modulates, or transforms, **digital signals** from a computer into the **analog** form that can be carried successfully on a phone line. It also demodulates signals received from the phone line back to digital signals before passing them to the receiving computer.

Intelligent modems with built-in software, such as Courier modems, simplify using phone networks for data communications.

**Nonvolatile Memory (NRAM)**

User-programmable random access memory whose data is retained when modem power is turned off. Used in Courier modems to store a user-defined default configuration loaded into random access memory (**RAM**) at power on.

**OFF/ON Hook**

Modem operations which are the equivalent of manually lifting a phone receiver (taking it off hook) and replacing it (going on hook).

**Originate Mode**

A state in which the modem transmits at the predefined low frequency of the communications channel and receives at the high frequency. The transmit/receive frequencies are the reverse of the called modem which is in **Answer mode**.

**Parallel Transmission**

The transfer of data characters using parallel electrical paths for each bit of the character, for example, 8 paths for 8-bit characters. Data is stored in computers in parallel form, but may be converted to serial form for certain operations. See **Serial Transmission**.

**Parity**

An error-detection method that checks the validity of a transmitted character. Character checking has been surpassed by more reliable and efficient forms of block-checking, including Xmodem-type protocols and the **ARQ** protocol implemented in Courier modems.

The same type of parity must be used by two communicating computers, or both may omit parity. When parity is used, a parity bit is added to each transmitted character. The bit's value is 0 or 1, to make the total number of 1's in the character even or odd, depending on which type of parity is used.

**Protocol** — A system of rules and procedures governing communications between two or more devices. Protocols vary, but communicating devices must follow the same protocol in order to exchange data. The format of the data, readiness to receive or send, error detection and error correction are some of the operations that may be defined in protocols.

**RAM** — Random Access Memory. Memory that is available for use when the modem is turned on and that clears of all information when the power is turned off. The Courier's RAM holds the current operational settings, a flow control **buffer**, and a command buffer.

**Remote Digital Loopback** — A test that checks the phone link and a remote modem's transmitter and receiver. Data entered from the keyboard is transmitted from the initiating modem, received by the remote modem's receiver, looped through its transmitter, and returned to the local screen for verification.

**Remote Echo** — A copy of the data received by the remote system, returned to the sending system and displayed on the screen. Remote echoing is a function of the remote system.

**ROM** — Read Only Memory. Permanent memory, not user-programmable. The Courier's factory settings are stored in ROM and can be read (loaded) into RAM as an operational configuration if DIP switch 10 is DOWN at power on.

**Serial Transmission** — The transfer of data characters one bit at a time, sequentially, using a single electrical path. See **Parallel Transmission**.

**Start/Stop Bits** — The signaling bits attached to a character before the character is transmitted during **Asynchronous Transmission**.

**SDLC** — Synchronous Data Link Control. A protocol developed by IBM for software applications and communicating devices operating in IBM's Systems Network Architecture (SNA). The protocol defines operations at the link level of communications, for example, the format of data **frames** exchanged between modems over a phone line. See **Bisync, Protocol, HDLC**.

**Synchronous Transmission** — A form of transmission in which blocks of data are sent at strictly timed intervals. Because the timing is uniform, no **Start** or **Stop bits** are required. Compare **Asynchronous Transmission**.

Some mainframes only support synchronous communications. Microcomputers in general only support asynchronous communications unless their owners have installed a synchronous adapter and appropriate software.

**Terminal** — A device whose keyboard and display are used for sending and receiving data over a communications link. Differs from a microcomputer in that it has no internal processing capabilities. Used to enter data into or retrieve processed data from a system or network.

**Terminal Mode** — An operational mode required for microcomputers to transmit data. In Terminal mode the computer acts as if it were a standard terminal such as a teletypewriter, rather than a data processor. Keyboard entries go directly to the modem, whether the entry is a modem command or data to be transmitted over the phone lines. Received data is output directly to the screen. The more popular communications software products control Terminal mode as well as enable more complex operations, including file transmission and saving received files.

**Throughput** — The amount of actual user data transmitted per second without the overhead of protocol information such as Start and Stop bits or **frame** headers and trailers. Compare **characters per second**.

**Transmission Rate** — Same as **Bit Rate**.

**V.21** A **CCITT** standard for modem communications at 300 bps. Modems made in the U.S. or Canada follow the Bell 103 standard. However, the Courier can be set to V.21 to enable overseas users to dial Courier modems in the U.S. or Canada. See S-Register 27 in Appendix B-5.

**V.22** A **CCITT** standard for modem communications at 1200 bps, compatible with the Bell 212A standard observed in the U.S. and Canada.

**V.22*bis*** A **CCITT** standard for modem communications at 2400 bps. The standard includes an automatic data rate fallback to 1200 bps which is compatible with Bell 212A/V.22 modems.

**V.25** A **CCITT** standard for modem communications that includes an answer tone sequence different from the Bell answer tone used in the U.S. and Canada. All Courier modems can be set with the B command so that they use this sequence to answer overseas calls.

**V.32** A **CCITT** standard for modem communications at 9600 bps that specifies 9600-bps transmission in both directions at the same time. V.32 design requires *echo canceling*, a technique that causes the modems to distinguish between actual signals and their echoes. Echoes are a serious problem on standard phone lines during high-speed data transmission. The addition of echo canceling makes V.32 modems more expensive than some other high-speed modems. Compare **HST**.

**Word Length** The number of bits in a data character without parity, start or stop bits.

**Xmodem** The first of a family of error control software protocols used to transfer files between modems. These protocols are in the public domain and available from many bulletin board services.

**XON/XOFF** Standard **ASCII** control characters used to tell an intelligent device to stop/resume transmitting data. In most systems typing <Ctrl>-S sends the XOFF character. Some devices, including the Courier, understand <Ctrl>-Q as XON; others interpret the pressing of any key after <Ctrl>-S as XON.

| | |
|---|---|
| USRobotics High Speed Technology (HST) | 14.4K bps, synchronous/asynchronous, asymmetrical, 14.4K/450 or 14.4K/300 bps with automatic handshake adjustment to 300 bps, Trellis Coded Modulation (TCM), Quadrature Amplitude Modulation (QAM) |
| | 12K bps, synchronous/asynchronous, asymmetrical, 12K/450 or 12K/300 bps with automatic handshake adjustment to 300 bps, Trellis Coded Modulation (TCM), Quadrature Amplitude Modulation (QAM) |
| | 9600 bps, synchronous/asynchronous, asymmetrical, 9600/450 or 9600/300 bps with automatic handshake adjustment to 300 bps, Trellis Coded Modulation (TCM), Quadrature Amplitude Modulation (QAM) |
| | 7200 bps, synchronous/asynchronous, asymmetrical, 7200/450 or 7200/300 bps with automatic handshake adjustment to 300 bps, Trellis Coded Modulation (TCM), Quadrature Amplitude Modulation (QAM) |
| | 4800 bps, synchronous/asynchronous, asymmetrical, 4800/450 or 4800/300 bps with automatic handshake adjustment to 300 bps, Quadrature Amplitude Modulation (QAM) |
| CCITT V.32 | 9600 bps, synchronous/asynchronous, Trellis Coded Modulation (TCM) and non-Trellis Coded Modulation |
| | 4800 bps, synchronous/asynchronous, Quadrature Amplitude Modulation (QAM) |
| Additional Compatibility Features | CCITT recommendation V.22*bis*, 2400 bps, synchronous/asynchronous, Quadrature Amplitude Modulation (QAM) |
| | Bell 212A, 1200 bps, synchronous/asynchronous, Differential Phase Shift Keying (DPSK) |
| | Bell 103, 300 bps, asynchronous, Frequency Shift Keying (FSK) |
| | CCITT V.21, 300 bps, asynchronous, Frequency Shift Keying (FSK) |
| | 300/110 bps, asynchronous, variable Frequency Shift Keying (FSK) |

| | |
|---|---|
| | USRobotics HST error control protocol, asymmetrical mode, at 14.4K/12K/9600/7200/4800 bps, similar to MNP Levels 1–4, with MNP Level 5 (data compression) |
| | Microcom Networking Protocol (MNP), Service Levels 1–5 in HST mode at 2400/1200 bps and in V.32 mode |
| | RS-232C terminal/modem interface |
| | Superset of industry standard AT command set, S-registers, DIP switches |
| DTE Rates | 38.4K, 19.2K, 9600, 4800, 2400, 1200, 300, 110 bps |
| Link Data Rates | HST mode: 14.4K, 12K, 9600, 7200, 4800, 2400, 1200, 300, 110 bps<br>V.32 mode: 9600, 4800, 2400, 1200, 300, 110 bps |
| Online Fallback/ Fall Forward | HST mode: 14.4K, 12K, 9600, 7200, 4800 bps<br>V.32 mode: 9600, 4800 bps |
| Phone Line Interface | RJ11, RJ12, RJ13, RJ41S, RJ45S phone jacks |
| Communications Channel | Full/half duplex on 2-wire dial-up, dedicated, or leased phone lines; demand-driven high speed channel turnaround in HST mode; symmetrical speeds in V.32 mode |
| Operational Modes | HST mode/V.32 mode, Synchronous/Asynchronous<br>Auto Dial/Answer, Manual Originate/Answer<br>Smart/Dumb mode |
| Dialing | Rotary (pulse 0–9), Touch-Tone (DTMF 0–9, #, *), a–z when in Quote (") Mode |
| Data Format, Asynchronous Mode | Binary, serial; defaults to 7-bit word length, even parity |

| Start Bits | Data Bits | Parity | Stop Bits |
|---|---|---|---|
| 1 | 7 | Even, Odd Mark, Space | 1 |
| 1 | 7 | None, Even, Odd, Mark, Space | 2 |
| 1 | 8 | None | 1, 2 |

**Front Panel Indicators**

HS High Speed (above 2400 bps)
AA Auto Answer/Answer
CD Carrier Detect
OH Off Hook
RD Received Data
SD Send Data
TR Terminal Ready (DTR)
MR Modem Ready/Test Mode
RS Request to Send
CS Clear to Send
ARQ Error control connection established
SYN Synchronous Mode

**Programmable S-Registers**

Values in parentheses are defaults:
Number of rings on which to answer (1)
Answer in Originate Mode
ASCII character definitions, decimal: escape code (43), Carriage Return (13), Line Feed (10), Backspace (8)
Auto Dial stored phone number on DTR, reset or power on
Disable MNP Levels 3, 4
Disable 450-bps back channel, force 300 bps
Inactivity Timer (0, disabled)
Modem self-testing (0, Data Mode)
Number of rings on which to answer (1)
Optional non-error control Transmit buffer size
Timing: Break length, to DTE (250 Ms)
Carrier Detect wait (60 sec)
Disconnect at loss of carrier (0.7 sec)
Escape code guard time (1 sec)
Forced hang-up delay to clear buffer (0 sec)
Pause in Dial, Repeat commands (2 sec)
Pulsed DSR (0 Ms)
Remote Carrier Detect before local recognition (0.6 sec)
RTS/CTS delay (10 Ms)
Touch-Tone duration, spacing (70 Ms)
V.32 answer tone sequence (0.8 sec)
Wait before dialing (2 sec)
V.21 modulation, 300 bps

| | |
|---|---|
| DIP Switch Functions | Externally accessible. Values in parentheses are factory settings: UP = OFF (open), DOWN = ON (closed).<br><br>Auto Answer (DOWN, AA suppressed)<br>Auxiliary (UP, result codes in Originate and Answer modes)<br>CD override (DOWN, ON)<br>Command Mode echo (UP, echo ON)<br>DTR override (DOWN, ON)<br>Load NRAM defaults/ROM factory settings (UP, NRAM)<br>Online Escape code with/without disconnect (DOWN, no disconnect)<br>Result code display (DOWN, displayed)<br>Result code mode (UP, verbal)<br>RS-232C Modem/Terminal data interface (UP, standard TX/RX assignments)<br>Smart/Dumb mode (DOWN, Smart) |
| Flow Control Buffers | Transmit Buffer—<br>Error control: 3.5k bytes<br>Non-Error control: 1.5k bytes, 128-byte option<br>Receive Buffer—2K bytes |
| Command Buffer | 40 characters, exclusive of AT prefix, Carriage Return and spaces |
| Control Commands | Adaptive dialing<br>Break handling<br>Command mode, online echoing<br>Command Mode/online toggle<br>Data compression<br>Data Set Ready (DSR) override<br>Dialing<br>Alphabetic string<br>Fast dialing, search for dial tone<br>One of four phone numbers stored in NRAM<br>Wait for answer, then continue<br>Wait for second dial tone, then continue<br>Error control<br>Error control result codes<br>Fixed/variable DTE and link rates<br>Flash switch-hook to transfer call<br>Leased line operation<br>Load ROM factory settings<br>Phone line interface<br>Received data flow control (hardware, software) |

| | |
|---|---|
| Control Commands, Cont. | Request to Send (RTS) override<br>Reset to NRAM defaults<br>Result code display ON/OFF<br>Speaker OFF, ON until CD, ON through CD and data transmission, ON after last digit dialed until CD<br>Standard, Extended, Advanced result code sets<br>Synchronous mode<br>Synchronous timing source<br>Transmit data flow control (hardware, software)<br>User-programmable nonvolatile memory (NRAM)<br>Verbal/numeric result codes<br>Voice/data communications |
| Test Options | Analog loopback<br>Analog loopback with test pattern<br>Dial test<br>Digital loopback<br>Remote digital loopback<br>Test pattern |
| Call Progress Codes | NO DIAL TONE<br>BUSY<br>NO ANSWER<br>RINGING<br>VOICE |
| Equalization | Adaptive |
| Transmitter Carrier Frequencies | USR-HST, 450 bps back channel<br>Originate Mode: 375 Hz<br>Answer Mode: 1800 Hz<br>USR-HST, 300 bps back channel<br>Originate Mode: 350 Hz<br>Answer Mode: 1800 Hz<br>V.32<br>Originate Mode: 1800 Hz<br>Answer Mode: 1800 Hz<br>V.22*bis*, Bell 212A<br>Originate Mode: 1200 Hz<br>Answer Mode: 2400 Hz |

Bell 103
- Originate Mode:
  - Mark: 1270 Hz
  - Space: 1070 Hz
- Answer Mode:
  - Mark: 2225 Hz
  - Space: 2025 Hz

V.21
- Originate Mode:
  - Mark: 980 Hz
  - Space: 1180 Hz
- Answer Mode:
  - Mark: 1650 Hz
  - Space: 1850 Hz

**Receiver Carrier Frequencies**

USR-HST, 450 bps
- Originate Mode: 1800 Hz
- Answer Mode: 375 Hz

USR-HST, 300 bps
- Originate Mode: 1800 Hz
- Answer Mode: 350 Hz

V.32
- Originate Mode: 1800 Hz
- Answer Mode: 1800 Hz

V.22*bis*, Bell 212A
- Originate Mode: 2400 Hz
- Answer Mode: 1200 Hz

Bell 103
- Originate Mode:
  - Mark: 2225 Hz
  - Space: 2025 Hz
- Answer Mode:
  - Mark: 1270 Hz
  - Space: 1070 Hz

V.21
- Originate Mode:
  - Mark: 1650 Hz
  - Space: 1850 Hz
- Answer Mode:
  - Mark: 980 Hz
  - Space: 1180 Hz

| | |
|---|---|
| Certification | FCC Part 68 & Part 15, Subpart J, Class B Domestic; DOC (Canada) |
| Power Adapter | UL listed, CSA approved, Supply voltage: 120 VAC RMS ± 10%, 60 Hz, + 5 VDC @750 MA, ± 12 VDC @200 MA |
| Power Consumption | 10 watts |
| Failed Call Timeout | 60-sec. default, programmable 2–255 sec. |
| Answer Tone Timeout | 60 sec. |
| Answer Tone Detector | 2200-2300 Hz |
| Loss of Carrier Timeout | (Disconnect Timer) 0.7-sec. default, programmable 0.2–25.5 sec. |
| Receive Sensitivity | -46 dBm Originate Mode; -44 dBm Answer Mode |
| Transmit Level | -9 dBm |
| Transmitter Frequency Tolerance | .01 % |
| Size | 8.30 x 12.65 x 1.57 inches |

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